FLUKE®

Biomedical

# Diagnostic Imaging

## Product Catalog

2009/2010

TNT 12000 X-Ray
Test Device

35080M/199XRAY kVp Divider
and Medical ScopeMeter

07-QRX Wireless QA RADCHEX
CR QC Productivity Device

76-424-4156 Nested CT
Dose Phantom Kit for
Pediatric/Adult Head and Body

**Fluke Biomedical.**
*Better products. More choices. One company.*

# Radiation Oncology Product Catalog

2009/2010

**Providing solutions, not just products**
Today, biomeds, physicists, RSO's, other medical personnel must meet increasing regulatory pressures, higher quality standards, and rapid technological growth, while performing their work faster and more efficiently than ever. Fluke Biomedical provides a diverse range of software and hardware tools to meet today's challenges.

**Service**
Fluke Biomedical is dedicated to providing the best service within the healthcare industry. Equipped with the best-credentialed facilities, onsite experts, and full asset-management capabilities, Fluke Biomedical's service team is always on call to take care of its customers. Fluke Biomedical's world-class staff leads the industry in post- and pre-sale support, including helping customers choose the best products and accessories for their needs, technical support, product calibration, and repairs.

**Regulatory compliance**
Fluke Biomedical's benchmark quality operates to the most rigorous standards in the industry, including compliance with ISO 9001:2000, ISO 13485:2003, FDA/QSR as applicable, and NRC/Part 50, Appendix B/Part 21 and adheres to ISO 17025:2005, ANSI Z540, Mammography MQSA and CNSC. Many of the Fluke Biomedical products are CE-marked and CSA-certified. In addition, the Global Calibration Laboratory holds its NVLAP Lab Code 200566-0 certification and is traceable to both the NIST & PTB.

**Legacy**
You may be familiar with some of our legacy brand names, including:

- Victoreen®
- Nuclear Associates
- Keithley
- Metron
- DNI Nevada
- Bio-Tek Instruments

Fluke Biomedical has taken the best elements and products of these former brands and have incorporated them into the Fluke Biomedical culture and product line available today.

**Our newest catalog**
Thank you for requesting our Radiation Oncology catalog. Within these pages, you will find solutions to manage your quality assurance and maintain a safe, regulatory-compliant facility in the radiation oncology physics field.

If you are interested in receiving catalogs or information about any of Fluke Biomedical's other product-lines, please visit www.flukebiomedical.com/catalog.

**Catalogs are available for the following product lines:**

- Biomedical Test
- Diagnostic Imaging QA
- Radiation Safety
- Service

## About Fluke Biomedical

Fluke Biomedical leads the world in the manufacture of biomedical test and simulation products, including standalone electrical safety testers to fully integrated and automated performance testing and documentation systems. Fluke Biomedical also provides some of the most trusted and accurate radiation safety, medical imaging, and oncology quality-assurance solutions for regulatory compliance.

## About Fluke Corporation

Fluke Biomedical is a division of Fluke Corporation. Fluke Corporation is the world leader in the manufacture, distribution, and service of electronic test tools and software and is a wholly owned subsidiary of Danaher Corporation (NYSE:DHR).

# Diagnostic Imaging Product Catalog

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# TNT 12000

## X-Ray Test Device

The TNT 12000 X-Ray Test Device is the newest and most versatile instrument available for measuring key x-ray imaging parameters. It sets up in seconds and measures kVp, dose, dose rate, time, and half value layer (HVL) in a single exposure. A totally-wireless ZigBee® interface enables quick and easy setup and the wireless detector can be used with the companion wireless display or a laptop computer.

X-ray imaging QA, calibration, and maintenance in today's demanding digital environment require very high productivity and compliance with local and regional regulations. The TNT 12000 delivers high productivity through 100 % wireless connectivity to either a display, which instantly responds with all values in a single exposure, or a laptop, where measured values are displayed and categorized in organized templates. Instant HVL with just a single exposure further enhances productivity.

Featuring all-in-one-exposure measurements and ZigBee wireless communication combined with the rugged, reliable, and accurate design that is a Fluke trademark, the TNT 12000 is truly a new breed of non-invasive x-ray test tool. TNT 12000 is ideal for use by OEM factory and field service engineers, independent service organizations, physicists, biomedical and clinical engineers, and local and regional field inspectors of x-ray imaging equipment. Its small, lightweight design enhances portability and 100 % wireless operation ensures setup can be accomplished in seconds. Because the TNT 12000 measures all parameters with every exposure, there is no need for complicated menu selection, further enhancing user productivity. TNT 12000 always defaults to the last use when powered on, so when used often for repetitive procedures it is truly a one-button (power-on) solution. The TNT 12000 has the expanded functionality needed for modern applications and can be managed with minimum keystrokes. Users can identify and select custom measurement protocols and save them for future use. Full test automation and documentation software is available for TNT 12000, creating the advantage of accurate, repeatable testing processes. Ansur Test Automation Software is only available from Fluke Biomedical.

### Primary end benefit

Productivity and accuracy are central goals when performing any maintenance or QA process on diagnostic imaging equipment because image system uptime is critical to patient care objectives. TNT 12000 is small, portable, and wireless. It is easily transported to the imaging room, set up in seconds, and all results are instantly available on the hand-held display or on the user's laptop. The latter application places measured values into templates that are standard with the Excel software provided with TNT 12000. Because the TNT 12000 Excel package is a spreadsheet, users can customize their templates and create their own reports to send to others. Accuracy, reproducibility, and reliability are also critically important and Fluke Biomedical is the industry standard customers count on to deliver uncompromised performance.

### Key features

- 100 % ZigBee wireless operation between detector and hand-held display or laptop
- Compact hand-held design for maximum portability and ease-of-use
- Simple user interface with minimum menu routines means setup in seconds
- Fluke Biomedical ruggedness provides reliable operation. It's tough!
- 40 kHz sampling rate to ensure accuracy with the most difficult applications
- Global support network delivering prompt service and peace-of-mind to Fluke Biomedical customers worldwide

# TNT 12000

## X-Ray Test Device

FLUKE® Biomedical

## Specifications

| | |
|---|---|
| **kVp measurements** | |
| **Units** | kVp Average (average of peaks during a specified interval) kVp Max (highest peak during a specified interval) PPV (peak practical voltage) |
| **Ranges** | |
| ***Radio/Fluoro modes*** | 40 kV to 150 kV |
| ***Mammo modes*** | Mo/Mo: 22 kV to 35 kV (standard calibration) |
| | Rh/Rh: 25 kV to 49 kV (optional calibration) |
| | Mo/Rh: 22 kV to 40 kV (optional calibration) |
| | Mo/Al: 22 kV to 49 kV (optional calibration) |
| | Rh/Al: 25 kV to 49 kV (optional calibration) |
| | W/Rh: (optional calibration) |
| | W/Ag: (optional calibration) |
| **Resolution** | 0.1 kV |
| **Accuracy** | Radio/Fluoro modes: ± 2 % or ± 1 kV, whichever is greater |
| | Mammo modes: ± 2 % or ± 0.7 kV, whichever is greater |
| **Reproducibility** | ± 1 % (std of 5 readings) |
| **Filtration correction range** | Radio/Fluoro modes: 1 mm Al to 10 mm Al or equivalent |
| | Mammo mode: 0 mm Al to 0.4 mm Al added filtration |
| **Dose/exposure measurements** | |
| **Units** | Roentgens, grays |
| **Range** | 0.5 mR to 999 R<br>5 µGy to 999 Gy |
| **Resolution** | 1 µR 0.01 µGy |
| **Accuracy** | ± 5 % |
| **Reproducibility** | ± 0.5 % (std % of five readings) |
| **Filtration correction range** | Radio/Fluoro modes: 1 mm Al to 10 mm Al or equivalent |
| | Mammo mode: 0 mm Al to 0.4 mm Al added filtration |
| **kV correction ranges** | Radio/Fluoro modes: 40 kV to 150 kV |
| | Mammo mode: Mo/Mo: 22 kV to 35 kV |
| **Dose/exposure rate measurements** | |
| **Units** | Roentgens or grays per hour, minute, second, pulse |
| **Range** | 8 mR/s to 10 R/s<br>70 µGy/s to 100 mGy/s<br>130 µR/pulse to 160 mR/pulse (@ 60 PPS)<br>12 µGy/pulse to 1.4 mGy/pulse (@ 60 PPS) |
| **Resolution** | 1 µR/s<br>0.01 µGy/s<br>0.02 µR/pulse (@ 60 PPS)<br>0.2 nGy/pulse (@ 60 PPS) |
| **Accuracy** | ± 5 % |
| **Filtration correction range** | Radio/Fluoro modes: 1 mm Al to 10 mm Al or equivalent |
| | Mammo mode: 0 mm Al to 0.4 mm Al added filtration |
| **kV correction range** | Radio/Fluoro modes: 40 kV to 150 kV |
| | Mammo mode: Mo/Mo: 22 kV to 35 kV |
| **Exposure time—radiographic modes** | |
| **Units** | Milliseconds, pulses |
| **Range (@ stated accuracy)** | Milliseconds: 10 ms to 9999 ms |
| | Pulses: 1 pulse to 999 pulses |
| **Resolution** | Milliseconds: 0.1 ms |
| | Pulses: 1 pulse |

### Optional accessories

**35035** mA/mAs Meter
**TNT 12000** Ansur Test Automation Software Plug-in

# TNT 12000

## X-Ray Test Device

FLUKE® Biomedical

## Specifications

| | |
|---|---|
| **Accuracy** | Milliseconds: 1 % or 0.5 ms |
| | Pulses: ± 1 pulse |
| **Reproducibility** | Milliseconds: 1 % or 0.5 ms |
| | Pulses: ± 1 pulse |
| **Elapsed time—fluoro modes** | |
| **Range** | 10 sec to 9999 sec |
| **Resolution** | 0.1 second |
| **Accuracy** | 1 % or 0.5 sec |
| **Average pulse rate—pulsed fluoro** | |
| **Range** | 1 pps to 999 pps (pulses per second) |
| **Resolution** | 1 pps |
| **Accuracy** | 1 pps |
| **Average pulse width— pulsed fluoro** | |
| **Range** | 10 ms to 999 ms |
| **Resolution** | 0.1 ms |
| **Accuracy** | 1 % or 0.5 ms |
| **HVL** | |
| **Range** | Radio/Fluoro modes: 1.2 mm Al to 10 mm Al (equivalent) |
| | Mammo mode: 0.2 mm Al to 0.6 mm Al (equivalent) |
| **Resolution** | Radio/Fluoro modes: 0.1 mm Al (equivalent) |
| | Mammo mode: 0.01 mm Al (equivalent) |
| **Accuracy** | Radio/Fluoro modes: ± 10 % or 0.2 mm Al (equivalent) |
| | Mammo mode: ± 5 % or 0.05 mm Al (equivalent) |
| **Electrical specifications** | |
| **Battery** | Battery type: Lithium-ion, 3.7 V, 4000 mAh |
| | Battery charge time: Approx. 5 hr |
| | Battery discharge time: Approx. 8 hr |
| | Battery cutoff voltage: 2.75 V |
| **AC adapter** | Input voltage: 100 V ac to 240 V ac |
| | Input frequency: 50/60 Hz |
| | Input current: 0.5 A (rms) |
| | Output voltage: 6 V dc |
| **Environmental specifications** | |
| **Operating temperature** | 0 °C to 35 °C (32 °F to 95 °F) |
| **Storage temperature** | -35 °C to 50 °C (-31 °F to 122 °F) |
| **Operating humidity** | 20 % to 80 % RH (non-condensing) |
| **Physical specifications** | |
| **Display** | 320 × 240 Color LCD |
| **Size (WxDxH)** | Display: 15.2 cm x 11.4 cm x 4.45 cm (6 in × 4.5 in × 1.75 in) |
| | Detector: 15.2 cm x 11.4 cm x 4.45 cm (6 in × 4.5 in × 1.75 in) |
| **Weight** | Display: 0.422 kg (0.93 lb) |
| | Detector: 0.68 kg (1.5 lb) |

### Optional accessories

**3335538** TA-TNT12K, TNT 12000 with Test Automation

**3340639** TA-TNT12KWD, TNT 12000 Wireless Detector with Test Automation

### Ordering information

**Kit #1**

**TNT 12000** X-Ray Test Device

**Included accessories**

**1320005000** TNT 12000WD Wireless Detector

**1330005000** TNT 12000D Wireless Display

**14-445** (2) AC Adapters/Chargers

**50-197** Cable, Type A to Mini B USB

**50-198** Cable, Mini A to Mini B USB

**1320003000** Excel Software/ User Manual on CD

**1320033000** Carrying Case

**90-183** ZigBee® USB Dongle

**TNT12QRG** Quick Start Reference Guide

**Kit #2**

**3335774** TNT 12000WD Wireless Detector

**Included accessories**

**1320005000** TNT 12000WD Wireless Detector

**14-445** (1) AC Adapter/Charger

**50-197** Cable, Type A to Mini B USB

**1320003000** Excel Software/ User Manual on CD

**1320033000** Carrying Case

**90-183** ZigBee® USB Dongle

**TNT12QRG** Quick Start Reference Guide

**Kit #3**

**3335795** TNT 12000D Wireless Display

**Included accessories**

**1330005000** TNT 12000D Wireless Display

**14-445** (1) AC Adapter/Charger

**50-197** Cable, Type A to Mini B USB

**50-198** Cable, Mini A to Mini B USB

**1320003000** Excel Software/ User Manual on CD

**TNT12QRG** Quick Start Reference Guide

# 35080M/199XRAY

## Non-Invasive kVp Divider and Medical ScopeMeter

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**The winning combination.**
The 35080M and 199XRAY are commonly used x-ray tools unmatched by traditional meters. This winning combination allows busy service engineers and biomedical personnel the ability to perform fast and accurate verification of kVp values for calibration or QA assessment. Fluke Biomedical offers this combination in a convenient kit with all the accessories you need to get started.

**35080M Non-Invasive kVp Divider**
The 35080M Non-Invasive kVp Divider quickly and accurately measures kVp for all modalities. The unit checks both above and below table tubes and displays the direct kVp values on either the 35050AT Dosimeter, the 199XRAY Medical ScopeMeter, or optional Excel Add-in software. The 35080M is highly portable and eliminates the need for bulky and heavy high-voltage divider tanks. In fact, it's so compact in size that it fits into a shirt pocket.

A patented* wide-range filter pack is included with the 35080M and provides accurate readings for the range of 50 kVp to 150 kVp. Four optional filter packs are available for use with the 35080M for CT, mammographic, and mobile applications.

**199XRAY Medical Scopemeter**
The 199XRAY Medical ScopeMeter has all the normal oscilloscope functions, as well as the speed, performance, and analysis power for more-demanding applications. This high-performance oscilloscope offers the functionality of top-end bench instruments. With up to 200 MHz bandwidth, 2.5 GS/s real-time sampling, and a deep memory of 27,500 points per input, the 199XRAY is ideal for engineers who need the full capabilities of a high-performance oscilloscope in a handheld, battery-powered instrument.

In addition, the 199XRAY is specially designed for use with x-ray systems. This ScopeMeter displays kVp waveforms and direct kVp values simultaneously on an easy-to-read screen, eliminating time-wasting calculations of scope traces to derive kVp values.

### Key features

**35080M**
- New miniaturized configuration for convenient transport to the job site
- Fast/easy non-invasive kVp values for calibration/QA
- Non-invasive technology eliminates the hazards of high-voltage cables and the need for bulky divider tanks
- Auto ON/OFF when connected/disconnected
- Optional filter packs enable testing in all modalities
- Rh/Rh measurement capability when 35080M is used with Cadmium K-Edge and Linear Mammo Filter Pack Pair
- Convenient storage/carrying case

**199XRAY**
- ScopeMeter displays kVp wave forms and direct kVp values simultaneously on an easy-to-read screen
- No more time spent calculating scope traces to derive kVp values
- Full medical oscilloscope scope functionality with color display
- ScopeMeter triggers on standard interlaced and high-resolution, non-interlaced video systems. Triggers on all lines nonselectively or select an individual video line—up to 2800 lines per frame
- mAs measurement calculates current over time
- Smart averaging capabilities
- Extended vertical offset
- Selectable persistence mode
- Extended video triggering
- FlukeView® for Windows® for documenting, enhancing, waveform analysis, and archiving results

# 35080M/199XRAY

## Non-Invasive kVp Divider and Medical ScopeMeter

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## Specifications

**35080M**

| | |
|---|---|
| **Range** | 50 kVp to 150 kVp, using only the wide-range radiographic filter pack (37617). Range and versatility are extended with the use of special optional filter packs. |
| **Accuracy** | ± 2 % of reading in the range of 50 kVp to 150 kVp, exclusive of linearity, filtration, and gain effects. Linearity corrections automatically applied when using 35080M with either 35050AT Dosimeter or 199XRAY. |
| **Response time** | 150 µs (10 % to 90 %) |
| **Calibration** | Internally generated signal provides a calibration check |
| **Minimum time for valid reading** | 1 ms, three-phase; one line cycle, single-phase |
| **Tube current** | Wide dynamic range from 4 mA to 3000 mA (three-phase), 2 mA to 1500 mA (single phase). Generator settings will vary in waveform and distance. Less than ± 1 kVp effect for wide-range radiographic filter pack covering 50 kVp to 150 kVp. Specialty filter packs may have different characteristics. |
| **Environmental** | Temperature range: 0 °C to 35 °C<br>Relative humidity: 20 % to 80 %<br>Storage temperature: -35 °C to 50 °C |
| **Orientation** | Long axis of the Model 35080M Non-invasive kVp Divider oriented perpendicular to axis of x-ray tube to eliminate heel effect. |
| **Power requirements** | 9 V battery, 60 hours operation |
| **Dimensions** (LxWxH) | 6 cm x 9 cm x 21 cm (2.38 in x 3.5 in x 8.25 in) |
| **Weight** | 0.68 kg (1.5 lb) |

**MA190 Accessory Kit**

The MA190 accessory set enables interconnection of the 199XRAY for use in the field of medical imaging and video systems. The kit is included with the 199XRAY as a standard accessory. The accessory kit includes the following:

- FlukeView for Windows software
- 50 Ω BNC feedthrough terminator, in insulated enclosure, to maintain proper termination of test connections during measurement
- 50 Ω BNC terminator with 10:1 signal attenuation, to keep test terminal properly loaded while getting optimum signal amplitude to benefit from the instrument's extended offset range
- 1 Ω current shunt for current measurements, in insulated enclosure
- Safety-designed BNC cable, 1.5 m (5 ft), with plastic connectors for safe connection to test terminals even when not at ground potential
- Insulated BNC (f) to 4 mm banana-plug adapter
- Dual 4 mm banana receptacles (1 red, 1 black)

# 35080M/199XRAY

## Non-Invasive kVp Divider and Medical ScopeMeter

FLUKE® Biomedical

## Specifications

### 199XRAY

| Field applications | |
|---|---|
| **Bandwidth** | Dual input: 200, 100 or 60 MHz |
| **Real-time sampling rate** | Up to 2.5 GS/s |
| **Trigger types** | Connect-and-View™ automatic triggering and a full range of manual trigger modes |
| **Extended video triggering** | Along with its triggering capability for standard, interlaced TV signals, the instrument also triggers on high-resolution, non-interlaced video systems. The ScopeMeter 199XRAY will trigger on all lines (nonselective), or can select an individual video line from systems with up to 2800 lines per frame. |
| **Persistence** | Digital persistence for analyzing complex dynamic waveforms, similar to an analog scope. |
| **Selectable persistence** | Persistence mode with selectable decay time helps to find anomalies in the wave shape and optimizes the display for color information when working with composite color video. |
| **Display** | Fast-display update rate for seeing dynamic behavior instantaneously |
| | Automatic capture and replay of 100 screens |
| **Maximum record length** | 27,500 points-per-input record length using ScopeRecord mode |
| **Trend analysis** | TrendPlot paperless chart recorder for trend analysis up to 22 days |
| **Independently floating isolated inputs** | Up to 1,000 V |
| **Waveform compare** | Waveform reference for visual comparisons and automatic pass/fail testing of waveforms |
| **Vpwm** | Vpwm function for motor drive and frequency inverter applications |
| **mA** | mAs measurement calculates current over time. Using the cursors, you can now measure directly the amount of radiation produced by x-ray systems, or the total amount of charge applied to a system. |
| **Smart averaging** | Smart averaging gives the averaged waveform over successive acquisitions, reducing noise in the displayed waveform. Thanks to smart averaging, you can now also see an incidental curve of a different wave shape with no effect on the averaged curve. This allows you to see the averaged curve of a sequence of video lines, for example, while still seeing the incidental flyback line flash by. The oscilloscope gives an immediate response when the signal makes large changes. |
| **Extended offset** | Vertical offset is now extended to a maximum of 16 divisions, allowing vertical zoom-in for study of small details of the signal. |
| **Electrical safety** | 1000 V CAT II and 600 V CAT III safety certified |
| **Power requirements** | Rechargeable NiMH battery pack, four hours operation |
| **Dimensions** (LxWxH) | 25.6 cm x 16.9 cm x 6.4 cm (10.1 in x 6.6 in x 2.5 in) |
| **Weight** | 2.0 kg (4.4 lb) |

### FlukeView® for Windows®

| | |
|---|---|
| **Documenting** | Transfer waveforms, screens, and measurement data from the ScopeMeter to a PC. Print or import the data into your report. |
| **Enhancing** | Add user text to individual ScopeMeter settings, providing guidance to the operator when recalling a setup. |
| **Archiving** | Create a library of waveforms with your comments for easy reference and comparison. Store complete replay cycles for analysis of waveform changes. Store complete memory content of the ScopeMeter on your PC for backup purposes. |
| **Waveform comparison** | Store reference waveforms, add operator instructions, and send both to the ScopeMeter for waveform comparison and "Pass/Fail" testing. |
| **Analysis** | Use cursors, perform spectrum analysis, or export data to other analysis programs. |

### Optional accessories

**33551** CT filter pack
**37351** Linear mammo filter pack
**37355** Cadmium K-Edge filter pack
**37946** Mobile filter pack
**38237** Low range filter pack

### Included accessories

**35080M/199XRAY**
**35080M** Non-Invasive kVp Divider
**199XRAY** Medical ScopeMeter
**MA190** Medical ScopeMeter Accessory Kit
**37617** Wide-range filter pack
**121002900** Carrying Case

**199XRAY**
**MA190** Medical ScopeMeter Accessory Kit

**35080M**
**37617** Wide-range filter pack
**1210029000** Carrying case

### Ordering information

**35080M/199XRAY** kVp Divider and Medical ScopeMeter Kit
**199XRAY** Medical ScopeMeter with kVp capabilities
**35080M** Non-Invasive kVp Divider

# 10100AT, 10500AT and 10500AMT

## TRIAD™ TnT X-Ray Field Service/ Calibration/QA Kit

FLUKE® Biomedical

The TRIAD™ TnT X-Ray Field Service/Calibration/QA Kit is a full-function, x-ray dosimeter kit that performs fast, highly-sensitive measurements. It is ideal for government compliance testing, troubleshooting, repair of diagnostic x-ray equipment, installation and setup of new equipment, preventive maintenance, radiographic QA measurements, and measurements required for JCAHO accreditation. The kit performs measurements for all modalities: radiographic, fluoroscopic, mammographic (MQSA), CT, cine and dental.

**The TRIAD TnT Kit comes in three popular configurations:**

- 10100AT is the base-level dosimeter kit and features the 35050AT dosimeter, a technologically advanced, microprocessor-controlled, x-ray radiation dosimeter. The kit also includes ion chambers and test stand, triaxial/coaxial cable, ac adapter, HVL filter set, RS-232 interface cable with adapters, customization software, instruction manual CD, and lightweight carrying case.
- 10500AT includes all of the components from the 10100AT, in addition to the 35080M non-invasive kVp divider and 37617 wide-range filter pack (50 kVp to 150 kVp), for quick and accurate kV measurement.
- 10500AMT is equipped with all the components from the 10500AT, as well as the 35035 mA/mAs meter and CA-23 universal test-lead kit, allowing engineers to accurately measure mAs and fluoroscopic mA for diagnostic, radiographic, and fluoroscopic imaging equipment.

### Key features

- Bright display with direct readout in user-selected units
- Image intensifier measurements at 0.1 µR and 0.1 µR/s resolution; cine in µR/frame
- Expanded kVp and exposure-time measurement capabilities
- Simplified controls include autoreset, autoranging, automatic offset and drift compensation, automatic power-down, and automatic pressure and temperature correction
- Optional TRIAD toolkit for Excel for remote operation, waveform capture, and calibration
- Multiple self-checking features to reduce testing time
- Battery-powered with auto power-down feature to extend battery life
- Automatic temperature and pressure correction for faster operation in any environment
- Timesaving scroll functionality
- Recognizes and ignores spurious background signals
- Very low dose rate: 20 nGy/s at a 1 nGy/s resolution
- Broader range of dental unit kV and time measurement

# 10100AT, 10500AT and 10500AMT

## TRIAD™ TnT X-Ray Field Service/ Calibration/QA Kit

FLUKE® Biomedical

## Specifications

### 10100AT TRIAD TnT Kit

| | |
|---|---|
| **Exposure and exposure rate accuracy** | |
| **Basic accuracy of 35050AT** | ± 1 % of reading ± 2 range resolution steps over range of 18 °C to 28 °C and ± 2 % of reading ± 2 range resolution steps over the full operating temperature range of 0 °C to 50 °C |
| Note: A 3 % NIST-traceable calibration is provided with each system and includes effects of 35050AT, 96035B, and 96020C. | |
| **Exposure time measurement** | |
| **Exposure time accuracy** | ± 0.1 % of reading; ± 0.2 msec |
| **Maximum exposure time** | 6.5 s |
| **Measurement resolution** | 0.2 ms |
| **Measurement modes** | |
| **kVp/Dose/Time** | Single-shot ("all-in-one" exposure), direct-beam measurement of exposure, kVp, and time; autoranging across three-decade ranges; auto reset between exposures; display updates after each exposure |
| **kVp/Rate** | Simultaneous measurement of kVp and exposure rate |
| **Full sensitivity dose** | Autoranging across five decades of sensitive ranges; automatic drift and offset compensation; automatic post-exposure display hold |
| **Full sensitivity rate** | Measurement range covers a span from low-level image intensifier measurements to unattenuated, direct beams; automatic offset compensation and nonlinear filtering. Autoranging provides five decades of sensitivity ranges. Display updates once per second |
| **Very low dose rate (VLDR)** | |
| This mode is only for making very low dose rate measurements. Nonlinear digital filtering and autoranging provide five decades of sensitivity ranges. Display updates once per second. In this mode, automatic current offset and drift compensation are disabled. As a result, the system can display very low dose rates. | |
| **Power requirements** | |
| **Battery life** | ~30 hours with six AA alkaline batteries; automatic power-down after user-selected period of unattended operation (5 min to 255 min); AC adapter supplied with each 35050AT |
| Note: When the ac adapter is in use, the auto power-down feature is disabled, providing continuous operation. User selections for ion chamber, units, kV filter pack, temperature, pressure, and frame are stored in nonvolatile memory before automatic turnoff; eliminates manual reselection at power-up | |
| **Bias voltage supply** | Fixed electronic bias (~300 V); bias voltage removed from triaxial input connector at instrument turnoff |
| **Customization** | Allows user to modify contents of nonvolatile memory, including ion chamber and kV filter pack conversion factors, temperature and pressure units, radiation units, and power down interval. A field customization software program is included for use with an IBM®-PC or compatible. |
| **Connections** | |
| **35080M Interface** | Male, two lug BNC |
| **Computer interface** | RS-232, using RJ-45 connector; 9,600 baud 8-bit, 1 stop, no parity, xon/xoff; enables fully-programmable operation and waveform display from a PC with optional Excel add-in; powered when connected to computer |
| **Ion chamber input** | Triax, BNC; collector and guard positive-biased relative to ion chamber body and dosimeter chassis |
| **Power** | 2.1 mm dc power jack, power input for an unregulated 9 V, 200 mA adapter with a center negative, 2.1 mm plug |
| **General information** | |
| **Display** | Two-line, 20-character alphanumeric PLED (polymer LED), with 0.5 cm character height; indicates all ion chamber/kV filter pack identification information, numerical measurement results, battery level, calibration date and other information |
| **Weight** | 6.4 kg (14 lb) |
| **Dimensions** (LxWxH) | 46 cm x 33 cm x 15 cm (18 in x 13 in x 6 in) |
| **Diagnostic Ionization Chambers (96035B and 96020C)** | |
| **Energy range** | 96035B: 30 kVp to 150 kVp; 20 kVp to 50 kVp for mammographic 96020C: 30 kVp to 150 kVp |
| **Nominal sensitivity** | 96035B: 2.00 R/C x 108 R/C (1.75 Gy/C x 106 Gy/C) at 22 °C and 1013 hPa 2.21 R/C x 108 R/C (1.94 Gy/C x 106 Gy/C) at 22 °C and 1013 hPa (flat response suitable for conventional diagnostic radiography and mammography) |
| | 96020C: 2.08 R/C x $10^7$ R/C (1.82 Gy/C x $10^5$ Gy/C) at 22 °C and 1013 hPa (optimized for low-level image intensifier and cine measurements) |
| **Construction** | 96035B: Graphite-coated acrylic, parallel-plate, air-vented |
| | 96020C: Composite graphite-filled thermoplastic; parallel-plate, air-vented |
| **Volume** | 96035B: 15 $cm^3$ |
| | 96020C: 150 $cm^3$ |

# 10100AT, 10500AT and 10500AMT

## TRIAD™ TnT X-Ray Field Service/ Calibration/QA Kit

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## Specifications

**10100AT TRIAD TnT Kit** (continued)

| Ion Chamber | Units | Effective Range *** | Resolution Step Size |
|---|---|---|---|
| **15 cc** | R | 100 µ to 20 | 1 µ |
| | R/s | 100 µ to 20 | 1 µ |
| | R/m | 5 m to 1200 | 50 µ |
| | R/h | 100 m 72 k | 1 m |
| | R/f ** | 2 µ to 333 m | 0.02 µ |
| | Gy | 1 µ to 175 m | 0.01 µ |
| | Gy/s | 1 µ 174 m | 0.01 µ |
| | Gy/m | 50 µ to 10.5 | 0.5 µ |
| | Gy/h | 1 m to 630 | 0.01 m |
| | Gy/f ** | 0.02 µ to 2.9 m | 0.2 n |
| **150 cc** | R | 10 µ to 2 | 0.1 µ |
| | R/s | 10 to 2 | 0.1 µ |
| | R/m | 0.5 m to 120 | 5 µ |
| | R/h | 10 m to 7.2 k | 0.1 m |
| | R/f ** | 0.2 µ to 33 m | 0.002 µ |
| | Gy | 0.1 µ to 17.5 m | 0.001 µ |
| | Gy/s | 0.1 µ to 17.5 m | 0.001 µ |
| | Gy/m | 5 µ to 1050 m | .05 µ |
| | Gy/h | 0.1 m to 63 | 0.001 m |
| | Gy/f ** | 0.002 µ to 290 µ | 0.02 n |
| **150 cc VLDR** | R/s | 2 µ to 2* | 0.1 µ |
| | R/m | 0.1 m to 120* | 5 µ |
| | R/h | 2 m to 7.2 k* | 0.1 m |
| | R/f ** | 0.04 µ to 33 m* | 0.002 µ |
| | Gy/s | 0.02 µ to 17.5 m* | 0.001 µ |
| | Gy/m | 1 µ to 1050 m* | 0.05 µ |
| | Gy/h | 0.02 m to 63* | 0.001 m |
| | Gy/f ** | 0.4 n to 290 µ* | 0.02 n |
| **Electrical Units** | C | 1 p to 100 n | 0.01 p |
| | A | 1 p to 100 n | 0.01 p |

Values for ion chambers are calculated using nominal sensitivities: 15 cc: 2.4 x $10^8$ R/C, 150 cc: 2.4 x $10^7$ R/C
*Very Low Dose Rate effective range at 5 % resolution steps.
**At 60 f/s (1 to 120 frames/selectable).
***IEC 61674 effective range at 1 % resolution steps

### 96020C and 96035B Diagnostic Ion Chambers

| | |
|---|---|
| **Energy range** | 96020C: 30 kVp to 150 kVp |
| | 96035B: 30 kVp to 150 kVp for diagnostic measurements; 20 kVp to 50 kVp for mammographic measurements |
| **Nominal volume** | 96020C: 150 $cm^3$; 11.3 cm diameter by 1.5 cm thick active volume |
| | 96035B: 15 $cm^3$; 3.96 cm diameter by 1.22 cm thick active volume |
| **Nominal sensitivity** | 96020C: H60: 2.08 R/C x $10^7$ R/C at 22 °C and 760 mmHg (optimized for low-level image intensifier and cine measurements) |
| | 96035B: L100: 2.0 R/C x $10^8$ R/C at 22 °C and 760 mmHg |
| | MV30 (PTB Mammo Point): 2.21 R/C x $10^8$ R/C at 22 °C and 760 mmHg (flat energy response suitable for conventional diagnostic radiography and mammography) |
| **Leakage current** | < 10 fA under normal bias conditions (300 V) |
| **Collection efficiency** | 96020C: 95 % at 2,000 R/min |
| | 96035B: 95 % at 5,000 R/min |

**96020C and 96035B**
- Very low leakage and low noise
- Rugged mechanical construction
- Ionization chambers are supplied with triaxial BNC connectors

### 96020C and 96035B Diagnostic Ion Chambers

The 96020C and 96035B Diagnostic Ion Chambers are vented-volume, parallel-plate air ionization chambers with side-mounted BNC triaxial connectors. The 96020C Ion Chamber has a nominal volume of 150 $cm^3$, and the 96035B has a nominal volume of 15 $cm^3$. Both ion chambers have a fully-guarded, centrally-located collector plate that provides superior collection efficiency.

The patented* 96035B has a dual-energy range that enables both diagnostic and mammographic measurements. They are accomplished using the other side as the entrance window.

*Patent numbers 4,843,619, 4,916,727 and 5,508,526.

# 10100AT, 10500AT and 10500AMT

## TRIAD™ TnT X-Ray Field Service/ Calibration/QA Kit

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## Specifications

**96020C and 96035B Diagnostic Ion Chambers** (continued)

| | |
|---|---|
| **Wall material** | 96020C: Composite graphite-filled thermoplastic |
| | 96035B: Graphite-coated acrylic (methyl-methacrylate) |
| **Window material** | 96020C: 0.76 mm thick, graphite-coated polycarbonate |
| | 96035B: Both entrance windows are made of 0.25 mm graphite-coated polycarbonate |
| **Window density** | 96020C: 91 mg/cm$^2$ |
| | 96035B: 32 mg/cm$^2$ |
| **Active window area** | 96020C: 100 cm$^2$, centered within the chamber body |
| | 96035B: Each side of the chamber has a circular active window region centered 7.1 mm further from the BNC connector than the center of the chamber body; active window regions have an area of 12.32 cm$^2$ |
| **Collector plate** | 96020C: 0.8 mm thick graphite-coated acrylic plate, 10.8 cm in diameter; 2.16 cm x 2.85 cm guard region electrically isolated from collector area |
| | 96035B: 0.25 mm thick, centrally mounted, graphite-coated, polycarbonate plate, 3.18 cm, ± 0.01 cm in diameter; 1.27 cm x 0.89 cm guard region is electrically isolated from the collector area |
| **Connector** | Side-mounted, triaxial, two-lug BNC connector |
| **Calibration** | 96020C Standard Calibration: Standard calibration performed at H60 (NIST defined as 60 kVp, first HVL of 6.0 mm Al, homogeneity coefficient of 94) |
| | 96035B Standard Calibration: Standard calibration performed at one diagnostic and one mammographic beam quality; calibration factors normalized to 22 °C and 760 mmHg |
| | Diagnostic Unattenuated Beam: Calibration on diagnostic side of chamber is performed at M80 (NIST defined as 80 kVp, first HVL of 2.97 mm Al, homogeneity coefficient of 57) |
| | Mammographic Beam: Calibration on mammographic side performed at Mo/Mo28 (NIST defined as 28 kVp, first HVL of 0.332 mm Al, homogeneity coefficient of 74.3) or MV30 (PTB defined as 30 kVp, first HVL of 0.337 mm Al) |

**35080M Non-Invasive kVp Divider**

| | |
|---|---|
| **Range** | 50 kVp to150 kVp, using only the wide-range radiographic filter pack (37617); range and versatility extended with use of special optional filter packs |
| **Accuracy** | ± 2 % of reading in the range of 50 kVp to 150 kVp, exclusive of linearity, filtration, and gain effects; linearity corrections automatically applied when using 35080M Non-invasive kVp Divider with either the 35050AT Dosimeter or the 199XRAY Medical Scopemeter |
| **Response time** | 150 µs (10 % to 90 %) |
| **Calibration** | Internally generated signal provides calibration check |
| **Minimum time for valid reading** | 1 ms, 3-phase; one line cycle, single-phase |
| **Tube current** | Wide Dynamic Range: From 4 mA to 3000 mA (3-phase), 2 mA to 1500 mA (single-phase) |

Note: Generator settings will vary in waveform and distance. Less than ± 1 kV effect for wide-range radiographic filter pack, covering 50 kVp to 150 kVp.
Specialty filter packs may have different characteristics

### Key features

**35080M**

- New pocket-size configuration
- Non-invasive technology eliminates the hazards of high-voltage cables and need for bulky divider tanks
- Auto ON/OFF when connected/disconnected
- Optional filter packs enable testing in all modalities
- Rh/Rh measurement capability when 35080M Non-Invasive kVp Divider is used with cadmium K-Edge and linear mammo filter pack pair

### 35080M Non-Invasive kVp Divider

The 35080M Non-Invasive kVp Divider quickly and accurately measures kV for all modalities. The unit checks both above and below table tubes, and the direct kV values are displayed on either the 35050AT Dosimeter or the 199XRAY Medical ScopeMeter. Derived kV can also be calculated using a storage oscilloscope. The 35080M Non-Invasive kVp Divider is highly portable and eliminates the need for bulky and heavy high-voltage divider tanks—so compact in size that it fits into a shirt pocket.

A patented* wide-range filter pack is included with the 35080M Non-Invasive kVp Divider and provides accurate readings for the range of 50 kVp to 150 kVp. Four optional filter packs are available for use with the 35080M Non-Invasive kVp Divider for CT, mammographic, and mobile applications.

## Specifications

**35080M Non-Invasive kVp Divider** (continued)

| | |
|---|---|
| **Environmental requirements** | Temperature range: 0 °C to 35 °C |
| | Relative humidity: 20 % to 80 % |
| | Storage temperature: –35 °C to 50 °C |
| **Orientation** | Long axis of the 35080M Non–invasive kVp Divider oriented perpendicular to axis of x-ray tube to eliminate heel effect |
| **Power requirements** | 9 V battery, 50 hours operation; battery–check function connects battery to output terminals for voltage measurement |
| **Dimensions** (LxWxH) | 6 cm x 9 cm x 21 cm (2.375 in x 3.5 in x 8.25 in) |
| **Weight** | 0.68 kg (1.5 lb) |

**35035 mA/mAs Meter**

| | |
|---|---|
| **Controls** | 1) Power mA/mAs switch, 2) Reset switch,<br>3) Range switch: 200 mA/mAs, 2000 mA/mAs and 20 mA range settings, 4) ac/dc switch |
| **Accuracy** | 1 % of reading ± two least significant digits for all ranges |
| **Environmental requirements** | Temperature range: 5 °C to 35 °C |
| | Relative humidity: 0 % to 80 % |
| | Storage temperature: –20 °C to 50 °C |
| **Display** | Liquid crystal display (LCD), 3.5 digit, .5 in H (13 mm) |
| **Input** | Two banana jacks |
| **Power requirements** | 9 V alkaline battery with easy replacement |
| **Dimensions** (LxWxH) | 15 cm x 5.0 cm x 8.75 cm (2 in x 2 in x 3.50 in) |
| **Weight** | 0.35 kg (0.78 lb) |
| Please refer to charts at the right for Miliamp, current and signal Input limit specifications for the 35035 mA/mAs Meter | |

| **Milliamp seconds (mAS)** | | |
|---|---|---|
| **Range** | **Resolution** | **Input impedance*** |
| 200 mAs | 0.1 mAs | 10 Ω |
| 2000 mAs | 1.0 mAs | 1 Ω |
| *Does not include fuse resistance. Also, does not include effect of bridge rectifier present when unit is set for ac specifications | | |
| **Current (mA)** | | |
| **Range** | **Resolution** | **Input impedance*** |
| 20 mA | 0.01 mA | 100 Ω |
| 200 mA | 0.1 mA | 10 Ω |
| 2000 mA | 1 mA | 1 Ω |
| *Does not include fuse resistance. Also, does not include effect of bridge rectifier present when unit is set for ac specifications | | |
| **Signal input limits** | | |
| **Function** | **Range** | **Max input limit** |
| mA | OFF | Input shorted; 2.0 A maximum (fuse protected) |
| | 20 | 250 mA for 30 s* |
| | 200 | 1.0 A for 30 s* |
| | 2000 | 2.0 A maximum (fuse protected) |
| mAs | 200 | 1.0 A for 30 s* |
| | 2000 | 2.0 A maximum (fuse protected) |
| *Limits set by power dissipation rating of shunt resistors | | |

# 10100AT, 10500AT and 10500AMT

## TRIAD™ TnT X-Ray Field Service/ Calibration/QA Kit

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**35035 Digital mA/mAs Meter**
The 35035 Digital mA/mAs Meter is a versatile instrument for x-ray service engineers, field service engineers, and biomedical engineers to measure mAs and fluoroscopic mA accurately for diagnostic, radiographic, and fluoroscopic imaging equipment. The 35035 Digital mA/mAs Meter operates with an easily-replaceable 9-volt alkaline battery for extra convenience and portability.

### Included accessories

**10100AT**
**35050AT** Dosimeter
**96035B** 15 $cm^3$ Ion Chamber
**96020C** 150 $cm^3$ Ion Chamber
**38208** Coax/triaxial Cable, 6 m (20 ft)
**37594** Programming Kit (37594), includes customization software on CD, two- meter RS-232 interface cable and adapters
**37581** Test Stand (37581), ion chamber stem, HVL filter tray
**37688** HVL filter set (37668)
**35050ATCD** User/service manual
**37500D** Kit Carrying Case

**10500AT**
Components in 10100AT Kit plus
**35080M** Non-Invasive kVp Divider
**37617** Wide-range Filter Pack (50 kVp to 150 kVp)

**10500AMT**
Components in 10500AT Kit plus
**35035** mA/mAs Meter
**A-23** Universal Test Lead Kit

### Ordering information

**10100AT** TRIAD TnT Dosimeter Kit
**10500AT** TRIAD TnT X-Ray Field Kit Service/Calibration/ QA Kit
**10500AMT** TRIAD TnT X-Ray Field Kit Service/Calibration/ QA Kit

### Optional accessories

**All Kits**
**500-100** CT Ion Chamber 3.2 $cm^3$
**500-200** CT Ion Chamber High Sensitivity, 10 $cm^3$, for Multislice CT
**07-434** Ultra-high Purity HVL Attenuators (for mammo set of six)
**10500EXL** TRIAD Toolkit for Excel
**38617** USB to RS-232 Adapter
**199XRAY** Medical ScopeMeter with kVp Capabilities (includes the MA190 Medical ScopeMeter accessory kit)

**10500AT and 10500AMT Kits**
**37355/37351** Mammographic Filter Pack Pair includes: Cadmium k-edge mammo filter pack (27.5 kVp to 29.5 kVp) ± 0.5 kV accuracy, linear mammo filter pack (22 kVp to 40 kVp) ± 1.0 kV accuracy

**Note:** Mammo filter packs are designed for molybdenum anode, beryllium window generators.

**37946** Mobile Filter Pack (50 kVp to 135 kVp) ± 2 % accuracy
**33551** CT Filter Pack (70 kVp to 140 kVp) ± 2 % accuracy kVp) ± 2 % accuracy
**38237** Low Range Filter Pack (30 kVp to 90 kVp) ± 2 % accuracy

**Available ac adapters**
**9 V, 200 mA**
**(specify with order)**
**14-106** USA and Japan
**14-107** Europe
**14-108** UK
**14-109** Australia

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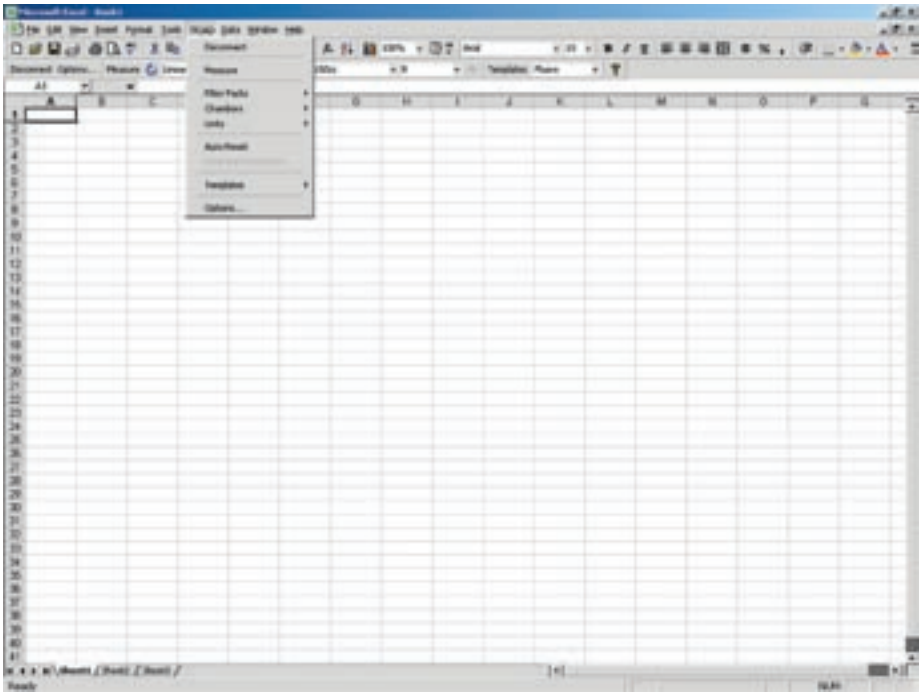
# 10500EXL

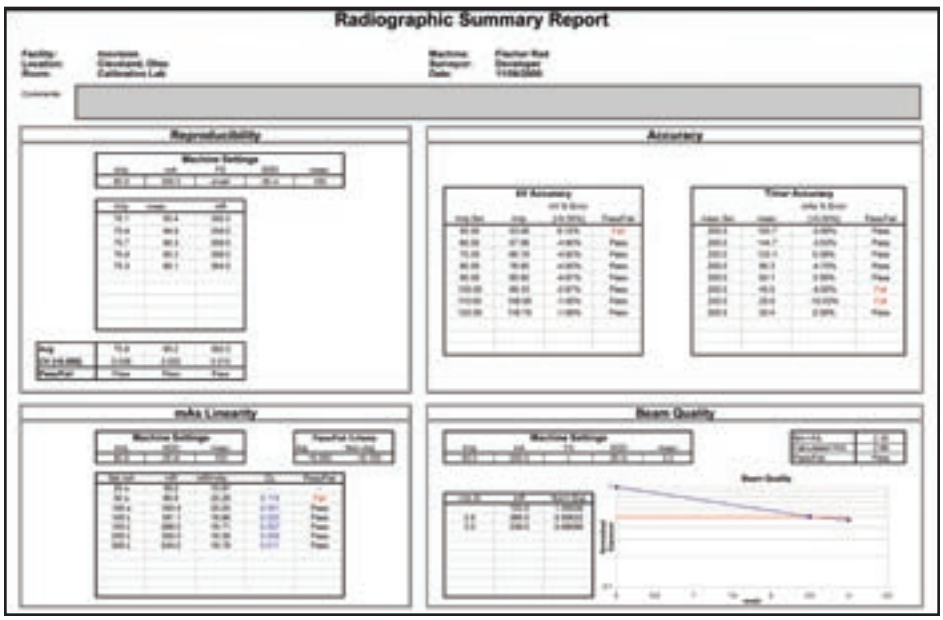
## TRIAD™ Toolkit for Excel



### Key features

- Automatically collects measurement results and places them in an Excel worksheet
- Automatically captures kV waveforms and charts them in an Excel worksheet
- Templates are provided for QA tests on radiographic, fluoroscopic and mammo-graphic x-ray machines
- Templates may be modified to perform user-specific tests and generate customized reports
- Allows complete remote control of the TRIAD
- Automatically downloads Model 35050A and 35050AT Dosimeter configuration settings
- Compatible with Windows® 2000 and above, and Microsoft® Excel 97, 2000

The TRIAD™ Toolkit for Excel is a complete software package for the TRIAD that includes an Excel Add-In, called TRIAD Tool, and Excel templates used to evaluate the performance of radiographic, mammographic, and fluoroscopic x-ray machines. The TRIAD Tool collects measured results from the 35050A and 35050AT Dosimeter and places the data in the active Excel worksheet. In addition, the TRIAD Tool may be used to acquire and graph kV waveforms from the TRIAD as well as remotely control the TRIAD Dosimeter.



# 10500EXL

## TRIAD™ Toolkit for Excel

FLUKE® Biomedical

## Specifications

| Controls | |
|---|---|
| The TRIAD Tools menu provides an interface to remotely control the TRIAD, select filter packs, chambers, units, retrieve kV waveforms, open templates, and change the options. A description of each control follows: | |
| **Connect/disconnect** | Connects or disconnects the TRIAD to the communications port. Connect instructs the TRIAD Tool to read configuration information such as the filter packs, chambers, and units. |
| **Options** | Several options can be specified including COM port, temperature, pressure, and frame rate. |
| **Measure** | Sets the TRIAD up for a single exposure using the selected filter pack, chamber, and unit |
| **Auto reset** | Informs the TRIAD Tool to automatically reset the TRIAD for another exposure, allowing a series of exposures to be made without used intervention. At the time Auto Reset is clicked, the TRIAD will be set up for an exposure. |
| **Filter packs** | Selects the filter pack to use for kVp measurements |
| **Chambers** | Selects the ion chamber to use for exposure measurements |
| **Units** | Selects the unit to use for exposure measurements |
| **Download waveform** | The Waveform button is enabled after an exposure is made and before the TRIAD is set up for another exposure. When the Waveform button is pressed, a dialog box prompts for the start and end times for the waveform chart, allowing the user to specify any portion of the kV waveform. The default start and end times are for the complete waveform. The waveform data is then placed in the active cell in the active workbook |
| **Help** | Opens the TRIAD Toolkit for Excel Instruction Manual |
| **Templates** | |
| Three templates are also provided with the TRIAD Toolkit for Excel: a radiographic template, a mammographic template and a fluoroscopic template. Each template includes a help worksheet with detailed instructions for its use. | |
| **The TRIAD radiographic template** | Is used to perform the following radiographic tests: reproducibility, kVp accuracy, timer accuracy, linearity, and beam quality |
| **The TRIAD mammographic template** | May be used to perform mammography tests required for ACR and MQSA. Measured data from the 35050A Dosimeter may be automatically collected in the following worksheets: kVp accuracy, kVp reproducibility, Beam quality, Breast entrance exposure, AEC reproducibility, average glandular dose, and radiation output rate |
| **The TRIAD fluoroscopic template** | Is used to perform the following fluoroscopic tests: kVp accuracy, beam quality, and fluoro exposure rate |
| These templates are easy to use and can be modified to fit the user's needs. | |

### System requirements

Windows 2000 and above
Microsoft Excel 97, 2000
One serial port (COM1 through COM4)

### Ordering information

**10500EXL** TRIAD Toolkit for Excel

FLUKE®
Biomedical

# 8000

## NERO® mAx X-Ray Test Device

The NERO® mAx, Non-invasive NERO mAx X-Ray Test Device, tests the spectrum of x-ray machines on the market today. Offering evaluation of pulsed fluoro, cine, computed tomography (CT), portable, mammographic, dental, radiographic, fluoroscopic, low-, medium-, and high-frequency machines with a single device, the NERO mAx is a benchmark instrument for quality and accuracy. This fifth generation quality assurance tool features 100 kHz sampling speed and direct mA/mAs measurements. The NERO mAx's innovative Easy Flow Menu (EFM) system and flexible soft keys provide an intuitive, user-friendly operating environment for quick, accurate, and easy measurements. All measurement modes and functions are displayed on the NERO mAx's super-bright LCD and are controlled by the five soft keys directly below the display and three hard keys to the right.

Seven user-selectable measurement modes and three system-control modes are available and clearly displayed on the control console screen for easy access and selection.

**Applications**

The NERO mAx consists of the control console, detector, detector cable, two filter cards, mAs leads, Excel Add-in, ac adapter, HVL plates, instruction manual, and carrying case.

The compact control console houses the rechargeable battery, super-bright easy-to-read backlit display, eight control buttons, and the sophisticated electronics necessary for accurate, reproducible measurements. Connectors for power input, RS-232, printer, scope output and the NERO mAx detector are located on the control console's rear panel.

The NERO mAx detector contains sensors for simultaneously measuring kV, exposure or rate and mA or mAs. Solid-state detectors are used to measure kV. An ion chamber, located in the top of the detector, is used for exposure/rate measurements. Connectors for external ion chambers and the NERO mAx detector interface are located on the rear panel of the detector. The front panel has a keyed opening for the NERO mAx filter cards and a connector for mAs leads.

The filter cards contain the various filters needed to accurately measure kilovoltage. Each filter card is coded so that the NERO mAx "knows" which filter is in use and its position. The NERO mAx also verifies that the filter card is valid for the selected measurement mode. The two filter cards are keyed so they may only be inserted properly. The W/Al filter card and the Mammo filter card are clearly labeled to the x-ray tube targets for which they are calibrated.

### Key features

- Non-invasive evaluation of radiation outputs
- 100 kHz sampling speed captures data from the most difficult machines
- 0.5 kV or 1 % accuracy from 22 kV to 160 kV
- Measures kVp average, kV effective, kV peak, time, exposure or rate, mA or mAs, HVL, exposure/frame, and mAs/frame
- Displays R or Gy
- Excel Add-in includes MQSA, Rad, and Fluoro templates
- RS-232 computer interface
- Enhanced dental capabilities

**External chambers**

External ion chambers for CT, mammographic, image intensifier tube, and special radiographic applications are available.

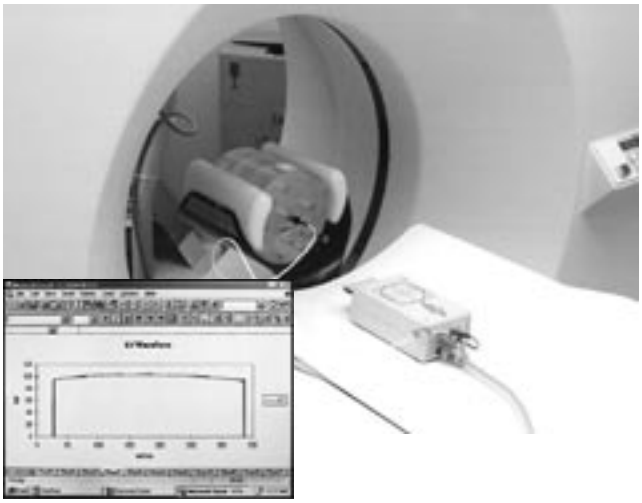
Chamber calibration factors can be stored in the NERO mAx for direct readout of measurements.

The Excel Add-in acquires measured data and waveforms directly into an Excel spread sheet to maximize flexibility for report generation.

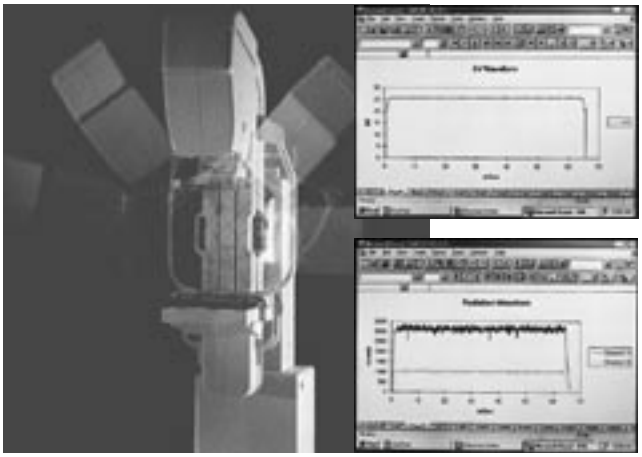
# 8000

## NERO® mAx X-Ray Test Device

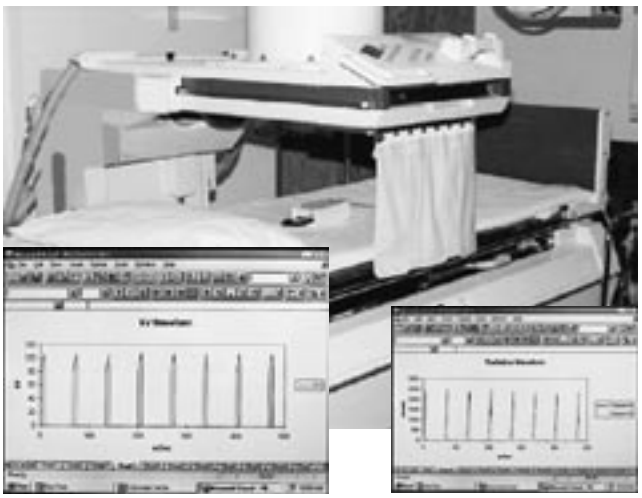
### Real-time CT

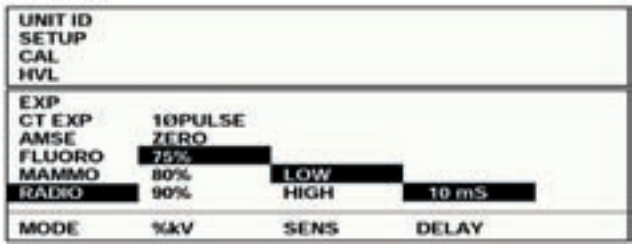


### High-frequency mammography



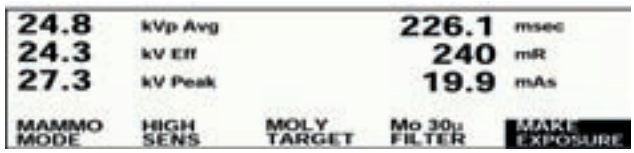
### Pulsed fluoro/AMSE






Easy Flow menu, Mode Select screen.

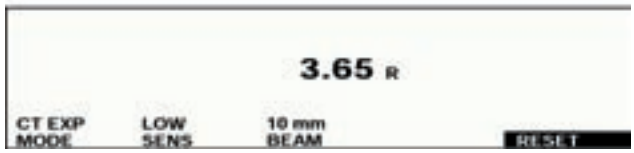
Easy Flow menu, Radio screen.



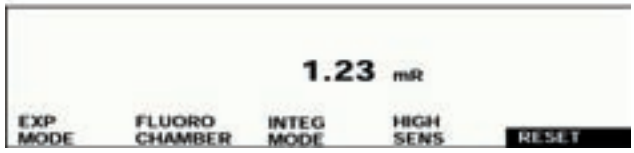

Easy Flow menu, Mammo screen.

Easy Flow menu, Pulsed Fluoro display.

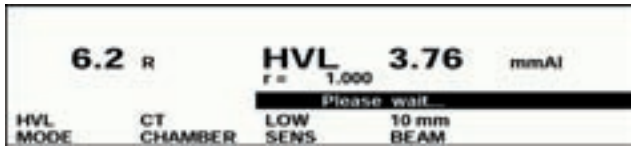
Easy Flow menu, AMSE screen.




Easy Flow menu, CT EXP screen.




Easy Flow menu, EXP screen.




Easy Flow menu, HVL screen.

## Specifications

| NERO mAx operating modes | |
|---|---|
| **Radio mode** | Radio mode is used to make measurements on tungsten target, aluminum-filtered radiographic x-ray generators. Selections are available for % kV peak for the type of generator being tested. For example, Zero Crossing, Single Phase Pulse, 75 %, 80 %, or 90 % of kVp modes are available for accurate exposure measurements on difficult x-ray machines. |
| | Radio mode simultaneously measures: kVp Avg, Exposure, kV Eff, Exposure time, kV Peak, kV Peak, and mAs. |
| **Mammo mode** | Mammo mode is used to make measurements on mammographic x-ray generators. |
| | Mammo mode simultaneously measures: kVp Avg, Exposure, kV Eff, Exposure time, kV Peak, and mAs. |
| **Fluoro mode** | Fluoro mode is used to make measurements on fluoroscopic x-ray generators. Fluoro mode supports both continuous fluoro and pulsed fluoro measurements. |
| | In the continuous fluoro mode, the NERO mAx measures: kVp Avg, kV Eff, exposure rate (R/min), mA, and kV Peak |
| | In the pulsed fluoro mode, the NERO mAx measures: kVp Avg, kV Eff, Exposure rate (R/min and mR/pulse), mAs/pulse, and kV Peak. |
| **AMSE mode** | AMSE mode is used for Automated Measurement of Sequential Exposures. This mode is used to measure the output of CINE generators. |
| | In AMSE mode, the NERO mAx measures: kVp Avg, Exposure rate (mR/frame), kV Eff, mAs/frame, kV Peak, and Time/frame (ms/frame) |
| **CT exposure mode** | CT Exposure mode is used to make CT exposure measurements using the 6000-100 CT ion chamber. The CT probe must be connected to the NERO mAx detector's external ion chamber input in this mode. |
| **Exposure mode** | Exposure mode is used to make exposure and rate measurements using the NERO mAx's internal ion chamber or an external ion chamber. |
| **HVL mode** | In the HVL mode, the NERO mAx calculates half value layer based upon a series of exposure or rate measurements made with varying thicknesses of aluminum absorbers placed in the x-ray beam. A minimum of two exposures are required and up to ten exposures may be used. |
| **Calibrate mode** | Calibrate mode is used to enter and store calibration factors for ion chambers used with the NERO mAx. |
| **Setup mode** | Setup mode is used to set the instrument's parameters such as the real time clock, temperature and pressure. |
| **Unit ID** | Displays the NERO mAx's serial number, firmware part number and level. |

| Optional external chamber accessories | |
|---|---|
| **6000-528** | 30 $cm^3$;<br>Energy response: within 7 % from 30 kVp to 150 kVp (15 keV to 65 keV);<br>Cable: 4.5 m (15 ft);<br>Chamber dimensions: 10.2 cm x 10.2 cm x 1.4 cm (4 in x 4 in x 0.54 in thick) |
| **6000-529** | 3.3 $cm^3$;<br>Energy response: within 5 % from 0.2 mm to 5.0 mm Al HVL (16 kVp to 90 kVp);<br>Cable: 4.5 m (15 ft);<br>Chamber dimensions: 4 cm Ø x 1.5 cm thick.<br>This chamber meets the needs of the MQSA for an external transparent chamber. |
| **6000-530B** | 150 $cm^3$;<br>Energy response: ± 10 % from 1.8 mm to 10 mm Al HVL;<br>Cable: 3 m (10 ft);<br>Chamber dimensions: 15.9 cm x 20.6 cm x 1.6 cm (6.26 in x 8 in x 0.63 in) |
| **6000-532B** | 400 $cm^3$;<br>Energy response: ± 5 % from 32 keV to 662 keV;<br>Cable 3 m (10 ft);<br>Chamber dimensions: 15.9 cm x 20.6 cm x 1.6 cm (6.26 in x 8 in x 0.63 in) |
| **6000-100 and 500-100 CT** | 3.2 $cm^3$;<br>Energy response: ± 5 % from 1 mm to 10 mm Al HVL;<br>Cable: 0.9 m (3 ft);<br>Sensitive length: 10 cm (4 in); chamber inside Ø: 6.4 mm (0.25 in) |
| **6000-200 and 500-200 CT** | 10 $cm^3$, for multislice CT;<br>Energy response: ± 5 % from 1 mm to 10 mm Al HVL;<br>Cable: 0.9 m (3 ft);<br>Sensitive length: 10 cm (4 in);<br>Chamber inside Ø: 11.44 mm (0.45 in) |

# 8000

## NERO® mAx X-Ray Test Device

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## Specifications

| | | | |
|---|---|---|---|
| **Kilovoltage** (Measured during the first 480 ms of exposure) | | | |
| **Measured quantity** | kVp Avg, kV Eff, kV Peak | | |
| **Accuracy** | 0.5 kV or ± 1% | | |
| **Reproducibility** | 0.5 kV or ± 1% | | |
| **Range** | **Target/Filter** | **Range** | **Filtration** |
| | W/Al | 30 kV to 60 kV | |
| | | 50 kV to 100 kV | |
| | | 80 kV to 160 kV | 1.2 mm of Al |
| | Mo/Mo | 22 kV to 35 kV | 30 µ of Mo |
| | Mo/Rh | 22 kV to 40 kV | 25 µ of Rh |
| | Mo/Al | 22 kV to 49 kV | 1 mm of Al |
| | Rh/Rh | 25 kV to 49 kV | 25 µ of Rh |
| | Rh/Al | 25 kV to 49 kV | 1 mm of Al |
| All calibrations performed with NIST traceable calibration beam. | | | |
| **Analyze/display cycle time** | | | |
| **Radio and mammo** | Three seconds for 0.1 second exposure, ine second for each 32 ms of exposure time | | |
| **Fluoro and AMSE** | 15 seconds for all exposures | | |
| **Time** | | | |
| **Radio mode** | Measured during entire exposure at 90 %, 80 %, 75 % rise/fall of waveform, zero crossing, or pulse count | | |
| **Mammo mode** | Measured during entire exposure at 90 % rise/fall of waveform | | |
| **Accuracy** | 1 ms | | |
| **Resolution** | 0.1 ms | | |
| **Range** | All diagnostic exposures from 1 ms to 60 seconds | | |
| **Exposure and rate** (Measured during entire exposure with automatic energy, temperature, and pressure correction) | | | |
| **Measured quantity** | Roentgens or grays | | |
| **Accuracy** | ± 5 % | | |
| **Reproducibility** | Radio and mammo modes: ± 2 % or 2 mR | | |
| **Resolution** | 0.1 mR | | |
| **Range** | All diagnostic exposure and rate measurements from 1 mR to 9999 R | | |
| **Fluoro rate** | 0.1 R/min to 999 R/min | | |
| **mAs and mA** (Measured invasively during entire exposure) | | | |
| **Accuracy** | 2 % | | |
| **Reproducibility** | ± 1 % or 0.2 mAs | | |
| **Range** | 0.1 mAs to 9999 mAs, 0 to 1000 mA | | |
| **HVL** | | | |
| **Accuracy** | ± 5 % | | |
| **Range** | 0.1 to 99.9 mmAl | | |
| **Physical** | | | |
| **Display** | Super-bright 240 x 60 pixel, super-twist LCD with cold cathode fluorescent backlight | | |
| **Detectors** | Ion chamber and solid-state (kV detectors) | | |
| **Ion chamber volume** | 45 cc nominal | | |
| **Window area/density** | 38 mg/cm$^2$ Polycarbonate | | |
| **HVL set** | 2.30 mm, 1.0 mm, 0.3 mm Al | | |
| **Power requirements** | 12 V dc 1 A external supply. Rechargeable internal batteries supply more than 4 hours of continuous service with overnight charge | | |
| **Size** | Volume: 0.065 m$^3$ (3960 in$^3$)<br>Console: 22.86 x 23.17 x 8.26 cm (9.00 x 9.12 x 3.25 in)<br>Detector: 16.66 x 9.4 x 6.55 cm (6.56 x 3.70 x 2.58 in)<br>Filter cards: 6.1 x 15.88 x 0.8 cm (2.4 x 6.25 x 0.31 in) | | |
| **Weight** | Shipping: 10.43 kg (23 lb)<br>Console: 2.067 kg (4.56 lb)<br>Detector (with card): 0.747 kg (1.65 lb)<br>Filter cards: 0.090 kg and 0.094 kg (2.9 oz and 3.2 oz) | | |

### Optional accessories

**07-434** Ultra-High Purity HVL Attenuators for mammo, set of 6

**External chamber accessories**

**6000-528** Radiographic Ion Chamber

**6000-529** Mammographic Ion Chamber

**6000-529-95** Probe Holder for BRH2 Test Stand

**6000-530B** Image Intensifier Ion Chamber

**6000-532B** Scatter Ion Chamber

**6000-100 and 500-100** CT Ion Chamber

**6000-200 and 500-200** CT High Sensitivity Ion Chamber

**Available ac adapters for (specify with order)**

**14-328** 110 V ac, 12 V dc, 1000 mA, USA and Japan

**14-401** 230 V ac, 12 V dc, 1000 mA, Europe

**14-414** 230 V ac, 12 V dc, 1000 mA, UK

**14-414 and14-416** adapter 230 V ac, 12 V dc, 1000 mA, Australia

### Included accessories

**8000-100-5** Control Console

**8000-101-5** Detector

**105-252** Detector Cable

**105-253** and **105-254** mAs Leads

**8000MAX** Excel Add-in

**38667** HVL Plates

**8000-200-1** Instruction Manual

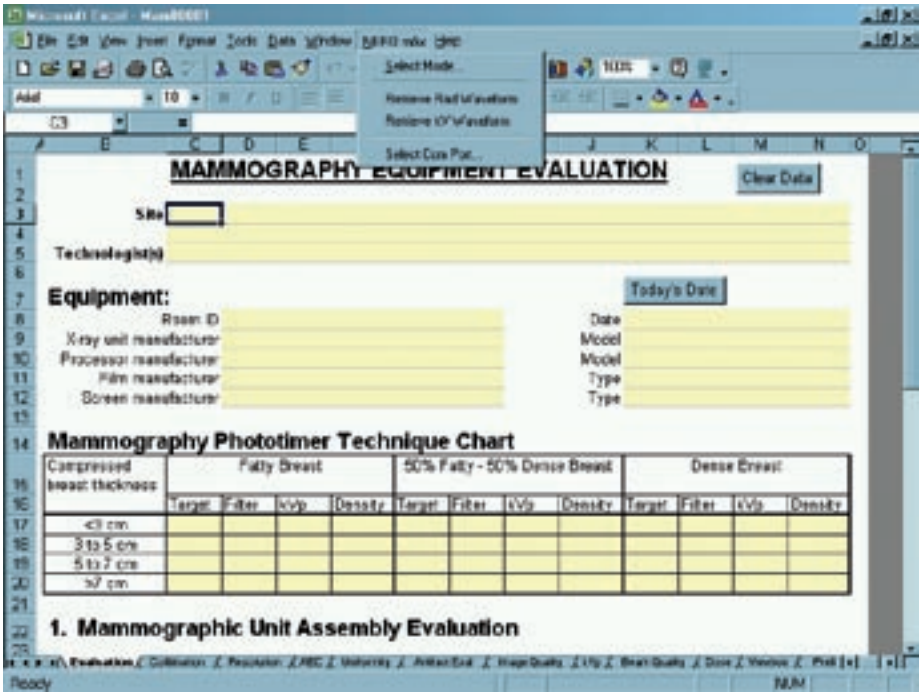
**8000-70** Carrying Case

### Ordering information

**8000** NERO mAx X-Ray Test Device

# 8000mAx

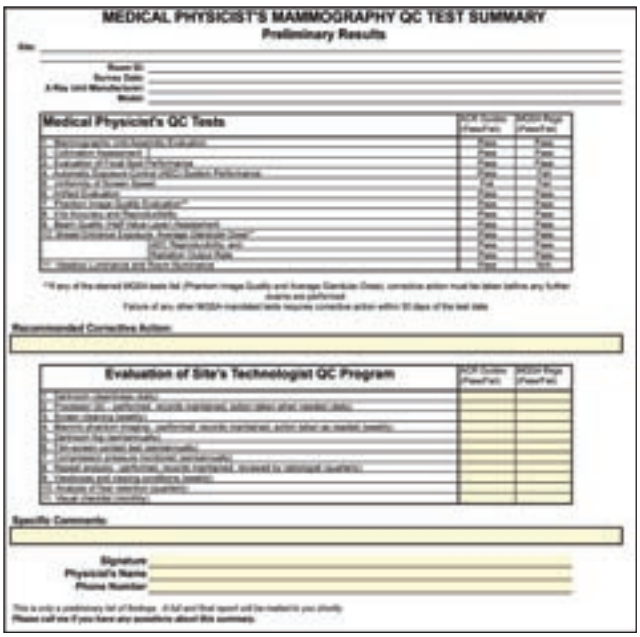
## NERO® mAx Toolkit for Excel




### Key features

- Automatically collects measurement results and places them in an Excel worksheet
- Automatically captures kV waveforms and charts them in an Excel worksheet
- Templates are provided for QA tests on radiographic, fluoroscopic, and mammographic x-ray machines
- Templates may be modified to perform user-specific tests and generate customized reports
- Allows complete remote control of the NERO mAx
- Complete online help speeds learning
- Compatible with Microsoft® Windows® 2000 and above, and Excel 97, 2000

The NERO® mAx Toolkit for Excel is a complete software package for the NERO mAx that includes an Excel Add-In, called NERO mAx Add-In and Excel templates that may be used to evaluate the performance of radiographic, mammographic and fluoroscopic x-ray machines. The NERO mAx Add-In collects measured results from the NERO mAx and places the data in the cells of the active Excel worksheet, starting at the active worksheet cell. The NERO mAx Add-In also may be used to acquire and graph radiation and kV waveforms from the NERO mAx as well as remotely control the NERO mAx.



# 8000mAx

## NERO® mAx Toolkit for Excel

FLUKE® Biomedical

## Specifications

| Controls | |
|---|---|
| The NERO mAx menu provides an interface for the user to remotely control the NERO mAx and retrieve radiation and kV waveforms. A description of each menu option follows: | |
| **Select mode** | Selects the NERO mAx measurement mode. This allows the user to select the correct measurement mode for the template in use. For instance, the radio mode is selected when using the radiographic template, the mammo mode is selected when using the mammographic template and the fluoro mode is selected when using the fluoroscopic template. |
| **Retrieve rad waveform** | Retrieves the radiation waveforms from the NERO mAx. When this is selected, a dialog box opens and the user may select either all of the waveform or a portion of the waveform to be charted. If a portion of the waveform is desired, the user prompted for start and end times (in milliseconds) of the waveform window. |
| **Retrieve kV waveform** | Retrieves the kV waveform from the NERO mAx. When this is selected, a dialog box opens and the user may select either all of the waveform or a portion to be charted. If a portion of the waveform is desired, the user is prompted for start and end times (in milliseconds) of the waveform window. |
| **Select com port** | Allows the user to choose serial communication port COM1—COM4 for 8000 NERO mAx connection. |
| **Templates** | |
| Three templates are also provided with the NERO mAx. Toolkit for Excel: a radiographic template, a mammographic template and a fluoroscopic template. Each template includes a help worksheet with detailed instructions for its use. | |
| **NERO mAx radiographic template** | Used to perform the following radiographic tests: reproducibility, kVp accuracy, timer accuracy, linearity, and beam quality |
| **NERO mAx mammographic template** | Used to perform mammography tests required for ACR and MQSA. Measured data from the Model 8000 NERO mAx may be automatically collected in the following worksheets: kVp accuracy, kVp reproducibility, beam quality, breast entrance exposure, AEC reproducibility, average glandular dose, and radiation output rate |
| **NERO mAx fluoroscopic template** | Used to perform the following fluoroscopic tests: kVp accuracy, beam quality, and fluoro exposure rate |
| These templates are easy to use and can be modified to fit the user's needs. | |

### System requirements

Windows 2000 and above
Microsoft Excel 97, 2000
One serial port (COM1 through COM4)

### Ordering information

**8000mAx** NERO mAx Toolkit for Excel

# 4000M+

## X-Ray Test Device

The 4000M+ X-Ray Test Device does it all. Simply place the instrument in the x-ray beam, make one exposure, and it serially displays kVp Maximum, kVp Average, kVp Effective, dose, and time. The Model 4000M+ then automatically resets for the next exposure. A CsI photodiode pair provides the kVp measurements through five user-selectable filter pairs. This ensures optimum accuracy over the entire diagnostic range with minimum filtration dependence. Exposure measurements are made with a parallel plate ionization chamber located above the filter wheel. Exposure time is measured with quartz crystal accuracy. Plus, a variety of external ion chambers may be connected for even greater flexibility.

### Key features

- Measures kVp maximum, kVp average, kVp effective, dose and time in one exposure
- Compact, lightweight design
- Displays R or Gy
- External ion chambers for Mammo, CT, image intensifier and phototiming measurements
- Automatic exposure reset for hands-off operation
- Rechargeable Ni-Cd batteries provide more than six hours of continuous service
- RS-232 computer interface
- Storage scope output for real-time waveform display
- Reversible display for fluoro measurements

## Specifications

| | |
|---|---|
| **Kilovoltage** | |
| **Accuracy** | 1 kV Mo/Mo (22 kVp to 35 kVp) (Mammo generators w/30 µ Mo) |
| **Range** | 38 mg/cm$^2$ Polycarbonate |
| | W/Al tubes: 27 kVp to 155 kVp |
| | Mo/Mo tubes: 21 kVp to 50 kVp |
| **Time** | |
| Measured during entire exposure at 90 % rise/fall of waveform | |
| **Accuracy** | Within 2 % or 2 ms, whichever is greater |
| **Range** | 1 ms to 10 seconds |
| **Exposure** | |
| Measured during entire exposure at 90 % rise/fall of waveform | |
| **Accuracy** | ± 5 % |
| **Range** | 10 mR to 10 R |
| **Fluoroscopic** | |
| Measured over one second intervals during fluoro exposure | |
| **Accuracy** | ± 5 % |
| **Range** | 0.5 to 200 R/min |
| **Detectors** | |
| kV CsI/photodiode pair measures x-ray transmission through differential attenuators | |
| **Time** | Computed from kV waveform stored in memory against quartz crystal time base |
| **Exposure** | Parallel plate ionization chamber |
| **Volume** | 36 cm$^3$ |
| **Window** | 38 mg/cm$^2$, 18.9 cm$^2$ polycarbonate |
| **Calibration** | Reference to a NIST traceable voltage divider and a calibrated exposure monitor during irradiation |

# 4000M+

## X-Ray Test Device

FLUKE® Biomedical

## Specifications

| Physical | |
|---|---|
| **Display** | 16 character dot-matrix LCD |
| **Controls** | Model 4000+ Five rocker switches |
| | On/Off: Power switch |
| | Radio/Fluoro: Select radiographic or fluoro operation |
| | High/Low: Select for sensitivity |
| | Roll: Roll thru data |
| | Exposure/All: Select exposure only for external ion chamber |
| | Mo/Mo or W/Al: Select anode/filter of x-ray tube |
| **Connectors** | Power: 9 V dc, 500 mA |
| | Scope: BNC for oscilloscope connection |
| | RS-232: DB-9 connector configured as DCE. BNC and banana plug for external Ion chamber |
| **Power requirements** | 9 V dc 500 mA external supply. Rechargeable internal Ni-Cd batteries supply more than six hours of continuous service with overnight charge |
| **Dimensions** (WxDxH) | 21.5 cm x 23 cm x 7.6 cm (8.5 in x 9 in x 3 in) |
| **Weight** | Approximately 1.59 kg (3.5 lb) |
| **HVL set** | Aluminum filters: 2.3 mm, 1.0 mm, and 0.3 mm |

| Optional external chamber accessories | |
|---|---|
| **6000-528** | 30 $cm^3$;<br>Energy response: within 7 % from<br>30 kVp to 150 kVp (15 keV to 65 keV);<br>Cable: 4.5 m (15 ft);<br>Chamber dimensions (HxWxT): 10.2 cm x 10.2 cm x 1.4 cm<br>(4 in x 4 in x 0.54 in) |
| **6000-529** | 3.3 $cm^3$;<br>Energy response: within 5 % from<br>0.2 mm to 5.0 mm Al HVL (16 kVp to 90 kVp);<br>Cable: 4.5 m (15 ft);<br>Chamber dimensions: 4 cm Ø x 1.5 cm thick.<br>This chamber meets the needs of the MQSA for an external transparent chamber. |
| **6000-530B** | 150 $cm^3$;<br>Energy response: ± 10 % from 1.8 mm to 10 mm Al HVL;<br>Cable: 3 m (10 ft);<br>Chamber dimensions (HxWxT): 15.9 cm x 20.6 cm x 1.6 cm<br>(6.26 in x 8 x 0.63 in) |
| **6000-532B** | 400 $cm^3$;<br>Energy response: ± 5 % from 32 keV to 662 keV;<br>Cable 3 m (10 ft);<br>Chamber dimensions (HxWxT): 15.9 cm x 20.6 cm x 1.6 cm<br>(6.26 in x 8 in x 0.63 in) |
| **6000-100 and 500-100 CT** | 3.2 $cm^3$;<br>Energy response: ± 5 % from 1 mm to 10 mm Al HVL;<br>Cable: 0.9 m (3 ft);<br>Sensitive length: 10 cm (4 in); chamber inside Ø: 6.4 mm (0.25 in) |
| **6000-200 and 500-200 CT** | 10 $cm^3$, for multislice CT;<br>Energy response: ± 5 % from 1 mm to 10 mm Al HVL;<br>Cable: 0.9 m (3 ft);<br>Sensitive length: 10 cm (4 in);<br>Chamber inside Ø: 11.44 mm (0.45 in) |

### Optional accessories

**4000EXL** 4000 Toolkit for Excel
**07-434** Ultra-High Purity HVL Attenuators for mammo, set of 6
**4000-69** Carrying Case
**190004** RS-232 Cable
7.6 m (25 ft), 9-pin to 9-pin

**External chamber accessories**

**6000-528** Radiographic Ion Chamber
**6000-529** Mammographic Ion Chamber
**6000-529-95** Probe Holder for BRH2 test stand
**6000-530B** Image Intensifier Ion Chamber
**6000-532B** Scatter Ion Chamber
**6000-100 and 500-100 CT** Ion Chamber
**6000-200 and 500-200** CT High Sensitivity Ion Chamber

**Available ac adapters for (specify with order)**

**14-301** 110 V ac, 9 V dc, 500 mA, USA and Japan
**14-399** 230 V ac, 9 V dc, 500 mA, Europe
**14-415** 230 V ac, 9 V dc, 500 mA, UK
**14-415 and 14-416** adapter 230 V ac, 9 V dc, 500 mA, Australia

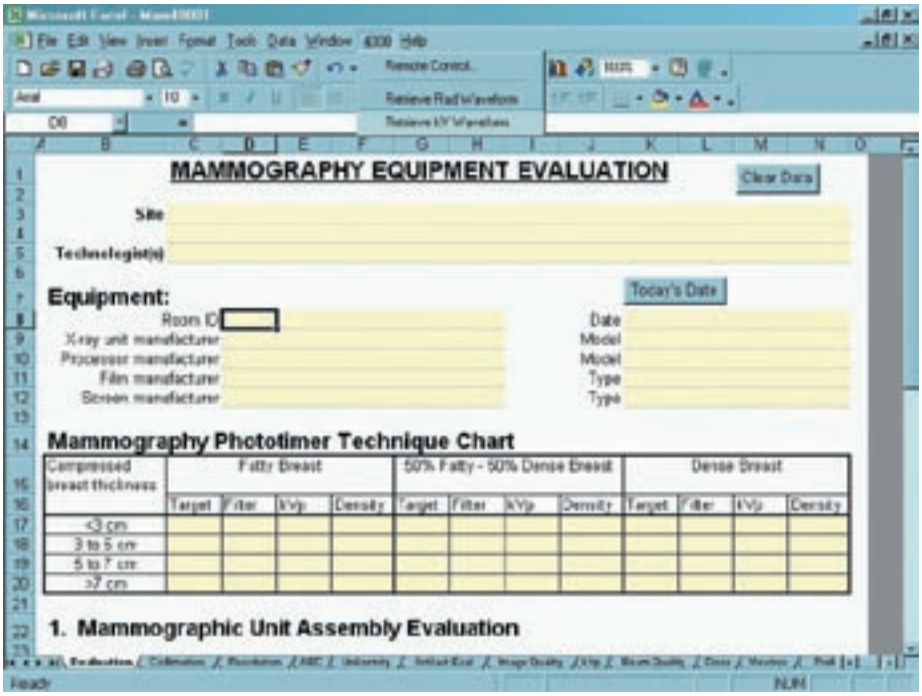
### Ordering information

**4000M+** X-Ray Test Device

# 4000EXL

## 4000 Toolkit for Excel

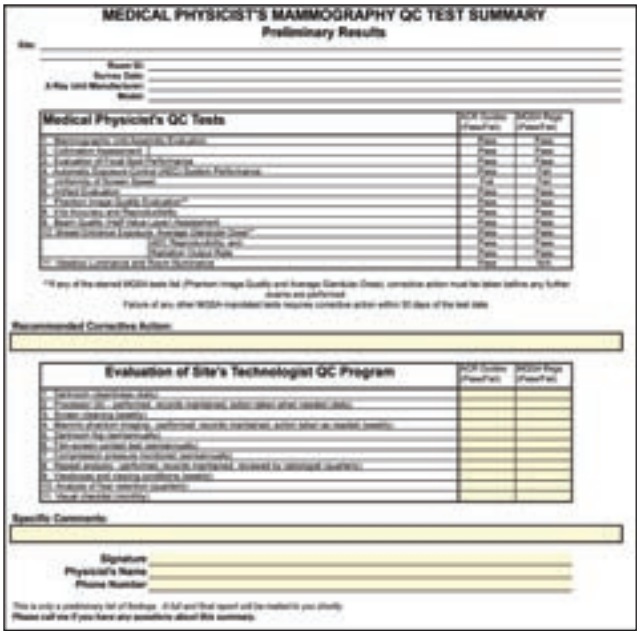
FLUKE® Biomedical




### Key features

- Automatically collects measurement results and places them in an Excel worksheet
- Captures radiation and kV waveforms and charts them in an Excel worksheet
- Templates are provided for QA tests on radiographic, fluoroscopic, and mammographic x-ray machines
- Templates may be modified to perform user-specific tests and generate customized reports
- Allows complete remote control of the 4000M+ NERO
- Complete online help speeds learning
- Compatible with Microsoft® Windows® 2000 and above, and Excel 95, 97, 2000
- Automatically detects the presence of 4000M+ NERO

The 4000 Toolkit for Excel is a complete software package for the 4000M+ NERO® that includes an Excel Add-In, called 4000 Add-In and Excel templates that may be used to evaluate the performance of radiographic, mammographic and fluoroscopic x-ray machines. The 4000 Add-In collects measured results from the 4000M+ NERO and places the data in the cells of the active Excel worksheet, starting at the active worksheet cell. The 4000 Add-In also may be used to acquire and graph radiation and kV waveforms from the 4000M+ NERO as well as remotely control the 4000M+ NERO.



# 4000EXL

## 4000 Toolkit for Excel

FLUKE® Biomedical

## Specifications

| Controls | |
|---|---|
| The 4000 menu provides an interface for the user to remotely control the 4000M+ NERO and retrieve radiation and kV waveforms. A description of each menu option follows: | |
| **Remote control** | Selects the 4000M+ NERO measurement mode and measurement options. This allows the user to select the correct measurement mode for the template in use. For instance, the radio mode is selected when using the radiographic template, the Mo/Mo target filter is selected when using the mammographic template and the fluoro mode is selected when using the fluoroscopic template. |
| **Retrieve rad waveform** | Retrieves the radiation waveform data from the 4000M+NERO and charts it in a new Excel chart. |
| **Retrieve kV waveform** | Retrieves the kV waveform data from the 4000M+ NERO and charts it in a new Excel chart. |
| **Templates** | |
| Three templates are also provided with the 4000 Toolkit for Excel: a radiographic template, a mammographic template and a fluoroscopic template. Each template includes a help worksheet with detailed instructions for its use. | |
| **4000 radiographic template** | Used to perform the following radiographic tests: Reproducibility, kVp accuracy, Timer accuracy, Linearity, and Beam quality |
| **4000 mammographic template** | used to perform mammography tests required for ACR and MQSA. Measured data from the Model 4000M+ NERO may be automatically collected in the following worksheets: kVp accuracy, kVp reproducibility, Beam quality, Breast entrance exposure, AEC reproducibility, Average glandular dose, and Radiation output rate |
| **NERO mAx fluoroscopic template** | Used to perform the following fluoroscopic tests: kVp accuracy, Beam quality, and Fluoro exposure rate |
| These templates are easy to use and can be modified to fit the user's needs. | |

### System requirements

Windows 2000 and above
Microsoft Excel 97, 2000
One serial port (COM1 through COM4)

### Ordering information

**4000EXL** 4000 Toolkit for Excel

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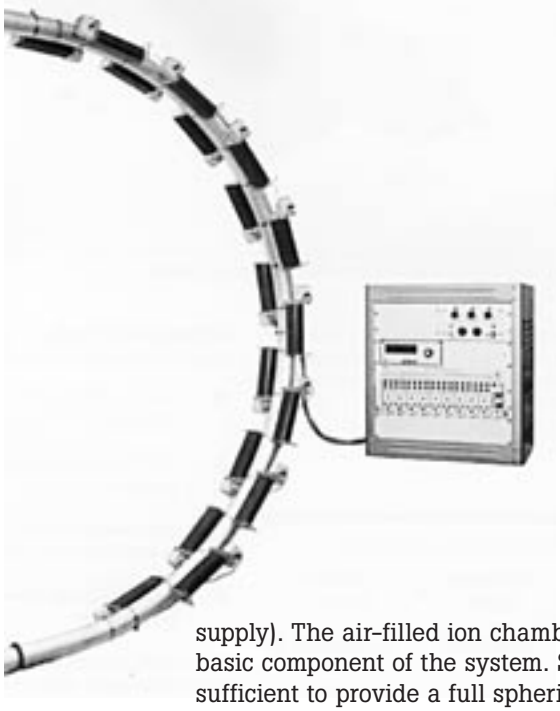
# 10970

## Crescent X-Ray Leakage Detection System



The Crescent X-Ray Leakage Detection System is custom designed for accurate low-level radiation measurements. When used in a suitable configuration, the system demonstrates compliance to Title 21 CFR subchapter J, Part 1020.30 (k) of the Radiation Control Act. The 10970 Crescent X-Ray Leakage Detection System consists of a combination of Ion Chamber/Electrometer Modules (96010A/50300A), and a Control Console (will include 70010A Dual Channel Comparator Modules, 70020 Reference Control Modules and power supply). The air-filled ion chamber/electrometer module is the basic component of the system. Seventeen of these modules are sufficient to provide a full spherical scan and are connected to the control console through low-impedance cable for remote monitoring. The Control Console contains the high-voltage ionization potential, a precision comparator and trip circuits, reference module, system control logic, and a spare HV power supply. The entire system has a modular design for add-on capability, interchangeability, and ease of maintenance.

### Applications

The only sure way to demonstrate compliance to leakage radiation standards is with a full spherical scan of the x-ray emitting products, such as diagnostic x-ray tubes. X-ray leakage tests are made easy for x-ray tube manufacturers and tube reloaders. A rapid 100 % production test can be less expensive than design analysis, analysis of tolerances and tolerance buildup, and costly quality control procedures and inspection. With the X-Ray Leakage Detection System, you can perform a full scan of your product in only two minutes.

### Key features

- Ion Chamber array performs x-ray leakage tests for diagnostic x-ray tube manufacturers and tube reloaders
- Demonstrates product compliance to the Radiation Control Act
- Standard 17-channel, 3-channel, or custom designed systems are available
- 17 chambers mounted around a semicircle of one meter radius provides 180° coverage with overlap between chambers
- Fast full spherical scan (two minutes)
- Direct readout in mR/hr
- Reliable modular construction
- Expandable from one to eighteen channels
- Highest channel readout

### System configurations

A basic 3-channel leakage radiation system can be assembled from an Ion Chamber/Electrometer Module used in combination with one 10970 Mainframe, two 70010A Dual Channel Comparator Modules, one 70020 Reference Control Module, and one High Voltage Power Supply. The system can expand up to 18 channels to provide a full spherical scan by adding plug-in modules. Listed below are two standard system configurations: a 17-channel and a 3-channel system. Any number of channels from three to 18 may be ordered. Details of system modules are described in the table.

### Leakage detection system configurations

| Module/Description | 17-channel system No. req. | 3-channel system No. req. |
|---|---|---|
| 96010A/Ion Chamber w/NIST traceable calibration | 17 | 3 |
| 50300A/Electrometer* | 17 | 3 |
| 10970/Mainframe† | 1 | 1 |
| 70010A/Dual Channel Comparator** | 9 | 2 |
| 70020/Reference Control Module | 1 | 1 |
| 55 foot interface cable | 9 | 2 |
| High-voltage supply | 1 | 1 |
| Ion chamber mounting ring and hardware | 1 | -- |
| High-voltage cable (17-channel) | 1 | -- |
| Rack Cabinet Control Module | 1 | -- |
| High-voltage cable (3-channel) | | 1 |
| Calibration current source | 1 | 1 |
| * Requires one per channel ** Requires two per channel † Specify 120 V ac or 22 V ac | | |

Note: Typical systems are configured with either 17 channels or 3 channels. All systems are custom designed. Spare components are recommended. On-site installation is recommended. Calibration source and standard NEMA® rack cabinet are required.

# 10970

## Crescent X-Ray Leakage Detection System

FLUKE® Biomedical

### 10970 Mainframe

The 10970 Mainframe includes a rack-mount cage designed to accept up to nine 70010A plug-in Dual Channel Comparator Modules and one 70020 Reference Control Module. The Mainframe incudes power supplies (± 15 V and 6.3 V dc) for up to eighteen 50300A Electrometers, nine 70010A Dual Channel Comparators, and one 70020 Reference Control Module.

50300A Electrometers are connected to the back panel of the Mainframe. Power required is 120 V ac or 220 V ac (specify at time of order). An output connector provides the contacts of the fault relay as well as the output of the highest channel in those systems using the Model 70010A.

### 96010A/50300A Ion Chamber/Electrometer Module

The 96010A Ion Chamber is constructed of air-equivalent plastic and is vented. The chamber has a window area of 100 $cm^2$ (5 cm x 20 cm), and a volume of 500 $cm^3$.

When used to demonstrate compliance to the Radiation Control Act, seventeen chambers mounted around a semicircle of one meter radius provide 180° coverage with overlap between chambers. The 50300A Electrometer may be combined with a 96010A Ion Chamber to eliminate the problems associated with high-impedance cable. The rise time is approximately 250 msec (10 % to 90 %) and the output noise is less than 10 mV, peak-to-peak (1 mR/hr peak-to-peak). Based on the typical characteristics of the Model 96010A Ion Chamber, the electrometer module is factory adjusted to provide a scale factor of one volt for 100 mR/hr NIST traceable ion chamber calibration.

### 70010A Dual Channel Comparator

The 70010A Dual Channel Comparator compares outputs of the 96010A/50300A Ion Chamber/Electrometer and any desired reference radiation level. An input reference voltage of 500 mV (50 mR/hr) can be set to demonstrate compliance to the Radiation Control Act. If the output of the ion chamber/electrometer exceeds this value, a bright red light initiates and remains illuminated until manually reset.

The 70010A Module has an adjustable gain and offset for the output of the 50300A Electrometer. Gain is adjusted to compensate for altitude so readings are correct for installations as high as 8000 feet above sea level. Normal changes in barometric pressure can typically be disregarded as they do not exceed ± 3 %. To correct reading for normal barometric pressure changes, a correction table is included.

The 70010A features two independent channels to connect each to a 50300A Electrometer. Fifty-five feet of cable (included) connect the electrometers to the back of the 10970 Mainframe. The 10970 supplies all required power.

The 70010A permits the highest output of all electrometers on the system to be read. You can use this output as the Y-axis on an X-Y plot to demonstrate that no output exceeds the 100 mR/hr legal level.

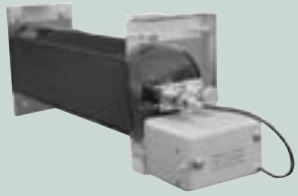
### 70020 Reference Control Module

The 70020 Reference Control Module sends a calibrated rejection level to the 70010A Dual Channel Comparators. You can set this level to between 0 and 100 mR/hr with a direct-reading dial setting.

The 70020 also provides a convenient voltage source to check the actual trip levels of each Dual Channel Comparator Module. All comparator modules are forced into the "fault" indication when the test switch is pressed to quickly check all channels. There are two operational modes: in the Interrupt mode a fault relay closes whenever any channel goes above the trip level; in the Continuous mode the relay is not activated. The relay contacts can activate an alarm or stop the drive motor when the system is scanning.

### Key features

**10970**
- Pre-wired mainframe
- Expandable system
- Line-operated
- Self-checking



**96010A/50300A**
- Fully-guarded air-equivalent chamber
- NIST-traceable calibration
- Electrometer directly connected to ion chamber
- Low-noise, high-speed performance

**70010A**

- Bright visual fault indication
- Altitude compensation
- Direct readout in mR/hr
- Front panel monitoring and test
- Readout of highest channel

**70020**

- Set mR/hr limits
- Two modes: interupt and continuous

### Ordering information

**10970** Mainframe
**96010A/50300A** Ion Chamber/Electrometer Module
**70010A** Dual Channel Comparator
**70020** Reference Control Module

# 07-CRXW and 07-QRX

## Wireless CR RADCHEX and QA RADCHEX

The wireless 07-CRXW CR RADCHEX and 07-QRX QA RADCHEX are factory radiation-calibrated, NISTtraceable light meters that can be used to calibrate (balance) CR plate readers (also radiation-calibrated light meters) in the field. The CR plate reader in the field will be calibrated and traceable to the Fluke Biomedical factory radiation-calibrated and traceable x-ray-produced light exposure.

CE

Both 07-CRXW and 07-QRX have the same x-ray energy response as a CR system (x-ray-to-light conversion efficiency is the same for various beam conditions). This enables them to be used as accurate and precise replacements for the plate reader's light measurement value (exposure index value).

Most importantly, the 07-CRXW and 07-QRX can save valuable time when calibrating or accessing CR readers and AEC used with multiple x-ray systems. These x-ray systems may have different filtration and beam characteristics even when located in the same department or imaging center. Balancing system performance and dose is an important QA requirement best satisfied with either the 07-CRXW or 07-QRX.

**Applications**

The wireless 07-CRXW is ideal for use by service engineers to initially calibrate and troubleshoot the CR plate reader, AEC, and density selector settings. Physicists use 07-CRXW to assess the performance of CR-AEC for compliance to clinical system speed objectives and patient dose. Radiology managers can use 07-CRXW to assist in the establishment of technique charts and training to determine ALARA techniques for various exam types. QA personnel can use 07-CRXW to periodically document the performance of the CR system and to compare CR to film/screen systems regarding desired ALARA objectives. The 07-CRXW uses Bluetooth® to communicate with a laptop computer so that the CRLU (CR Light Units), EI (Exposure Index) and estimated mR values measured by the electronic cassette are automatically recorded and displayed on the laptop screen.

**Benefits**

Using the 07-CRXW to calibrate x-ray system AEC and CR plate readers instead of a dosimeter can improve productivity significantly. A full system AEC and CR plate reader calibration process can take as much as six hours. Employing the 07-CRXW the process can be completed in under two hours. A substantial productivity gain for service, biomedical or physics professionals.

Essentially, the wireless 07-QRX performs all of the functions of the 07-CRXW, however CRLU and speed numbers (representing the relative system speed of the CR system compared to a film/screen system) are displayed on a LCD readout built into the electronic cassette. A pressure sensitive On/Off switch activates the 07-QRX and is used to reset the meter between exposures. The values may be manually entered into the software program on a laptop or PC if desired but a laptop is not required to use the 07-QRX. The 07-CRXW and 07-QRX are designed to work with all major brands of CR equipment.

The 07-QRX QA RADCHEX is ideally suited for fast and easy daily checks of AEC and CR system exposure continuity. Data obtained from daily checks can be used for trend analysis of individual systems as well as a way to monitor the balanced performance of CR systems throughout the healthcare enterprise.

### Key features

- Calibrates computed radiography (CR) plate readers and automatic exposure control (AEC)
- Assesses ongoing performance of CR plate reader, AEC, and automatic programmed radiography (APR)
- Sets and maintains desired clinical system speed (dose) of the CR system
- Calibrates CR plate readers in the field to be traceable to a factory radiation-produced light condition
- Links radiation exposure (mR) to the front of the plate accurately and predictably to a CR light measurement value (CRLU)
- Provides a reliable and reproducible method of accurately maintaining a CR manufacturers' specific factory calibration
- Provides three different tube-head filtration choices for users who desire a non-filtered beam condition for field plate reader calibration
- Software selections of multiple beam conditions for different CR manufacturers
- Ideal tools for service engineers, physicists, and quality assurance personnel

# 07-CRXW

## Wireless CR RADCHEX

FLUKE® Biomedical

## Specifications

| | |
|---|---|
| **X-ray energy dependence** | Simulates relative light output of photostimulatable phosphor plate (PSP) within ± 3 % over kVp range of 60 kVp to 120 kVp and a patient equivalent thickness range of 5 cm to 35 cm (within specified operating rates) |
| **Digital range** | Computed radiography light units:<br>CRLU (AEC#); 0 to 500<br>CRLU (AEC#); 0 to 5000 (07-QRX) |
| **Minimum CRLU rate** | 1.5/sec (approx. 0.15 mR/sec entrance exposure rate),<br>7/sec (approx. 0.7 mR/sec entrance exposure rate) (07-QRX) |
| **Maximum CRLU rate** | 2500/sec (approx. 250 mR/sec entrance exposure rate), 25000/sec (approx. 2500 mR/sec entrance exposure rate) (07-QRX) |
| **Power on/off** | Manual switch |
| **Controls** | Wireless communications with computer software; Bluetooth wireless communications (07-CRX only) |
| **Functions** | Measures CRLU (AEC#); converts CRLU to CR manufacturers specific CR plate reader light exposure index value (EI); user selectable; calculates cassette input exposure values for various x-ray beam conditions (exposure in mR plus backscatter) |
| **Power requirements** | Built-in NiMH rechargeable battery pack (9.6 V) |
| **Typical battery life between charging** | 5 hours, 20 hours (07-QRX) |
| **X-ray beam filter** | 1.5 mm copper (B152-110); 6 in x 6 in complete with velcro straps to attach to x-ray tube collimator housing |
| **Environmental requirements** | Operating temperature: 15 °C to 35 °C (59 °F to 95 °F) |
| **General information** | |
| **Electronic cassette dimensions** (WxDxH) | 30 cm x 24 cm x 1.3 cm (12 in x 10 in x 0.5 in) |
| **Weight** | 1.8 kg (3.9 lb) |
| **Computer software** | CD-ROM containing Microsoft® Excel program |
| **Computer requirements** | Computer capable of running Windows® 98 or higher with Microsoft Excel, Computer not required to operate (07-QRX). Software is provided with (07-QRX) to manually enter values if desired |

### Optional accessories

**07-AEC6** For film/screen applications to assess and calibrate automatic exposure control (AEC) – radiographic and mammographic systems

**07-AEC6M** For film/screen applications to assess and calibrate automatic exposure control (AEC) – mammographic systems

### Ordering information

**07-CRXW** Wireless CR RADCHEX, including PC-based Excel documentation software

**07-QRX** Wireless QA RADCHEX, including PC-based Excel documentation software

# 07-MAS5

## mAs Meter

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The 07-MAS5 mAs Meter simultaneously provide mAs, exposure time, and mA, as well as mA waveform information. This intelligent meter displays three 50-milliseconds mA waveform samples so radiographic and mammographic pre-heat circuits can be analyzed and adjusted without using an oscilloscope. Based on feedback from field service engineers, the 07-MAS5 also features a button that causes the meter to ignore the first 10-milliseconds of the mA waveform. Featuring a microcontroller to analyze the digital mA waveform, the 07-MAS5 mAs Meter accurately display the values essential for analyzing and calibrating radiographic and mammographic equipment.

CE

**The four line LCD displays the following:**

**Line 1 mAs** (average tube current (mA) times mA waveform exposure time)

**Line 2 Exposure time** (mA waveform exposure time in seconds)

**Line 3 mA** (average tube current (mA) over the entire mA waveform)

**Line 4 Three sample mA waveform values:**

1st waveform value represents the average mA for the 1st 50 milliseconds of exposure

2nd waveform value represents the average mA for the 2nd 50 milliseconds of exposure

3rd waveform value represents the average mA for the 3rd 50 milliseconds of exposure

### Key features

- An intelligent meter that measures mAs, exposure time, and mA all at the same time
- Provides mA waveform information
- At a button press, the 07-MAS5 meter ignores the first 10 milliseconds of exposure
- AC and DC inputs
- A diagnostic power-up sequence to indicate operational status
- Auto LCD update
- Optional manual reset
- Automatic power-down when meter is not used for more than five minutes
- Displays when an exposure is detected
- Low battery indication

## Specifications

| | |
|---|---|
| **Reset** | Auto LCD update; optional manual reset |
| **Dynamic range** | 10 mA to 2000 mA; 0.1 mAs to 999.9 mAs; 1 ms to 6.535 sec |
| **Accuracy** | mAs: ± 0.1 mAs or 1 % (whichever is greater) |
| | mA: ± 1.0 mA or 0.5 % (whichever is greater) |
| | Time: ± 1 ms or 1 % (whichever is greater) |
| **Operating temperature** | 15 °C to 35 °C (59 °F to 95 °F) |
| **Power requirements** | One 9 V battery |
| **Typical battery life** | > 40 hours |
| **Size** | 10.16 cm x 16.51 cm x 0.84 cm (4 in x 6.5 in x 0.33 in) |
| **Weight** | 0.28 kg (0.625 lb) |

### Ordering information

**07-MAS5** mAs Meter

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# 660

## X-Ray and CT Exposure Measurement Instrument

The 660 X-Ray and CT Exposure Measurement Instrument is the optimum choice for flexibility in x-ray and computed tomography (CT) exposure measurement. The 660 consists of a readout, carrying case, and choice of four optional ion-chamber-based probes with built-in calibrations, allowing interchangeability to customize the instrument to a particular measurement requirement. The 660 instrument is suitable for use for energies ranging from mammography through 1.3 MeV.

The 660 measurement readout is part of a complete x-ray and CT exposure measurement instrument that saves time and effort during routine diagnostic quality assurance measurements. This portable and light-weight readout device with large three-digit LED display can be used with any of the four optional interchangeable ion-chamber-based probes to cover a range of 1.0 µR to 100 R in the exposure mode and 0.1 mR/min to 1000 R/min in the rate mode. The 660 readout can be line operated or powered by NiCad rechargeable batteries.

Each 660 Series ion-chamber-based probe contains an electrometer that permits probe calibration independent of the readout. The ion chamber current signal is then digitized, and this digital signal is then transmitted over the cable to the readout resulting in a virtually noise-free transmission of data unaffected by cable length or stress. Cables are available up to 76 meters (250 feet).

**Applications**

The 660 X-Ray and CT Exposure Measurement Instrument is suitable for in-beam and scatter exposure and exposure-rate measurements of diagnostic x-ray beams, mammographic range x-ray machines, as well as CT output measurements, depending on the ion-chamber-based probe(s) selected. The ease of portability of this instrument makes it an excellent choice for measurements necessary in maintaining a diagnostic quality-assurance program for several machines and modalities.

### Key features

- Digital, auto-ranging, data display
- Electrometer in probe handle
- Digital signal transmitted over shielded cable for noise immunity
- Automatically calibrated and adjusted for any 660 series probe
- Available in SI units
- Includes fitted carrying case
- Exposure or exposure-rate modes
- Rechargeable batteries or ac power
- Built-in calibration auto-ranging
- Very portable

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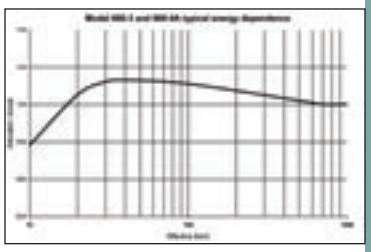
Biomedical

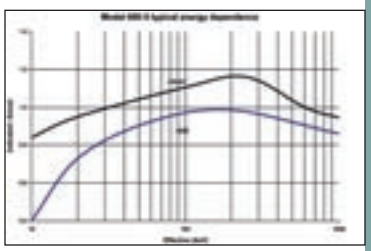
# 660

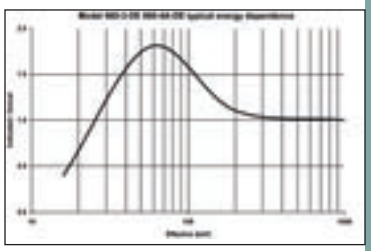
## X-Ray and CT Exposure Measurement Instrument

## Specifications

| | |
|---|---|
| **Range** | Three-decade auto-ranging and auto-indicating with proper decimal placement and measurement units. See selected ion chambers' specifications for specific ranges. |
| **Calibration** | Unnecessary. Response depends on frequency of internal crystal oscillator (± 0.01 % from 10 °C to 40 °C) |
| **Accuracy** | Depends only on crystal oscillator frequency in Exposure Rate mode. See selected probe's specifications for measurement accuracy. |
| **Controls** | Function switch: selects off, total exposure or exposure rate modes<br>Reset switch: selects run, stop, or reset (in Total Exposure Mode)<br>Intensity knob: controls readout brightness |
| **Error prevention logic** | Low battery—auto turnoff; OverRange indicator; Excessive intensity indicator; Probe disconnected indicator |
| **Display,** | Three-digit LED legends; R/min, R/hr, mR/hr, R, mR, mSv/min, mSV/h, mSv, and µSv |
| **Battery life** | Six hours between charges at 20 °C with normal usage. Automatic shutoff when charge drops below usable level. |
| **Battery complement** | One 67.5 V collecting potential (shelf-life) and four rechargeable 1.25 V "D" batteries for instrument power |
| **Battery charge time** | 10 hours to full recharge at 20 °C (instrument OFF) |
| **AC recharge input** | 117 V ± 15 % 50/60 Hz power cord furnished 230 V ± 15 % availableon special order |
| **Dimensions** (WxDxH) | 14 cm x 21.6 cm x 11.4 cm (5.5 in x 8.5 in x 4.5 in) |
| **Weight** | 3.2 kg (7 lb) net |

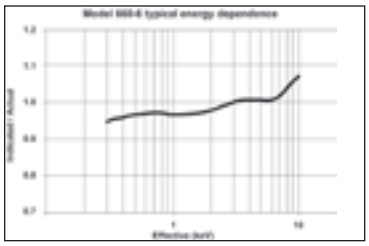


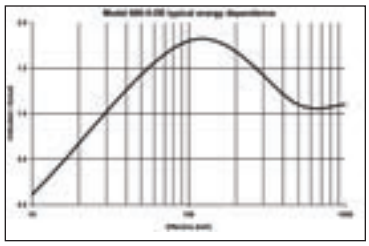




### Ion Chambers

| | 660-3<br>660-3DE | 660-4A<br>660-4DE | 660-5<br>660-5DE | 660-6 |
|---|---|---|---|---|
| **Application** | Diagnostic Beam Measurement | | Scatter | CT |
| **Probe volume** | 4 $cm^3$ | | 400 $cm^3$ | 3.2 $cm^3$ |
| **Measurement area** | 10 $cm^2$ | | 100 $cm^2$ | NA |
| **Maximum rate** | 999 R/min | 99.9 R/min | 9.99 R/hr | 999 R•cm/min |
| **Maximum exposure** | 99.9 R | 9.99 R | 99.9 mR | 99.9 R•cm |
| **Resolution on most sensitive range rate (Exposure)** | 10 mR/min (1 mR) | 1 mR/min (0.1 mR) | 0.1 mR/hr (1 µR) | 0.01 R•cm/min (0.001 R•cm) |
| **Intensity limit for 99 % collection efficiency** | 40 R/sec | 1.8 R/sec | 10.8 R/hr | 985 R/min |





### Optional accessories

**660-3** Parallel Plate Ion Chamber, 4 $cm^3$, 99.9 R
**660-3DE** Parallel Plate Ion Chamber, 4 $cm^3$, 99.9 R, dose equivalent
**660-4** Ion Chamber, 4 cc
**660-4DE** Parallel Plate Ion Chamber, 4 $cm^3$, 99.9 R, dose equivalent
**660-5** Parallel Plate Ion Chamber, 400 $cm^3$
**660-5DE** Parallel Plate Ion Chamber, 400 $cm^3$, dose equivalent
**660-6** CT Ion Chamber, 3.2 $cm^3$

### Included accessories

**660-1-69** Foam-lined Carrying "brief" Case
**660-1-44** 2 ft Ion Chamber Cable
**660-1-45** 10 ft Ion Chamber Cable
**660-1-54** AC Rechargeable Cable
**660-1-1BCD** Instruction Manual

### Ordering information

**660** X-Ray and CT Exposure Measurement Instrument, 110 V

FLUKE®
Biomedical

# 06-526

## RAD-CHECK® Plus Dosimeter

The 06-526 RAD-CHECK Plus uses proven technology specifically designed to provide you with the ultimate in versatility and cost-effective operation.

Accurate, lightweight, portable; this industry-standard dosimeter enables you to gain the critical edge in your QC program.

Battery operation and built-in detector virtually eliminate setup time. Just place the meter or external ion chamber on x-ray table; collimate, shoot, and read the result.

Precision ion chamber and digital display ensure accuracy plus easy readability.

### Key features

- Entrance skin exposure measurements (ESE)
- Fluoroscopy exposure measurements
- Exposure checks; radiographic (mR/mAs)
- Beam quality; half value layer (HVL)
- mAs reciprocity; mA station checks, plus many others, depending on the remote external chambers used
- The American College of Radiology (ACR) recommends this type of product in their quality-assurance program
- Fast and easy use
- Battery operation and built-in detector eliminate setup time
- Measures dose up to 2 R; dose rate up to 20 R/min
- Energy response is ± 5 % from 30 kVp to 150 kVp for the RAD-CHECK PLUS internal chamber
- Optional remote chambers for mammographic and cine imaging systems
- Extremely compact 15 cm x 15.9 cm x 7 cm (6 in x 6.25 in x 2.75 in); weighs only 0.51 kg (1.125 lb)

## Specifications

| | |
|---|---|
| **Ranges** | 0.001 R to 2 R, 0.01 R/min to 20 R/min |
| **Internal chamber** | 30 cc volume, energy response ± 5 % from 15 keV to 65 keV (30 kVp to 150 kVp filtered). 20.5 $cm^2$ (5.1 cm Ø) effective measurement area. Center of chamber 1.03 cm below top of chamber |
| **Standard calibration** | At 75 kVp with 4 mm Al filtration at 22 °C and one atmosphere |
| **Reproducibility** | Within 2 % short-term over 100 mR to 2 R range (1 mGy to 20 mGy) |
| **Electrometer drift** | 0.5 to 1 mR/min typical; 6 mR/min maximum (5 µGy to 10 µGy; 60 µGy/min maximum) |
| **Maximum exposure rate** | Minimum 90 % collection efficiency at 20 R/sec |
| **Automatic reset** | Resets display to zero; can also be reset manually |
| **Operating temperature** | 10 °C to 40 °C |
| **Relative humidity** | 0 to 90 %, non-condensing |
| **Display** | 3.5 in x 0.5 in LCD, low battery indicator |
| **Controls** | Auto or manual reset selector. Display zero reset button. Dose or dose-rate output selector. Integral or remote ion chamber selector. On/off switch |
| **Power** | 9 V alkaline battery, > 100 hours operation (50 hours in manual reset mode) |
| **Dimensions** (WxDxH) | 15.25 cm x 15.9 cm x 7 cm (6 in x 6.25 in x 2.75 in) |
| **Weight** | 0.51 kg (1.125 lb) |

| **Optional external chamber accessories** | |
|---|---|
| **6000-528** | 30 $cm^3$; Energy response: within 7 % from 30 kVp to 150 kVp (15 keV to 65 keV); Cable: 4.5 m (15 ft); Chamber dimensions: 10.2 cm x 10.2 cm x 1.4 cm (4 in x 4 in x 0.54 in thick) |
| **6000-529** | 3.3 $cm^3$; Energy response: within 5 % from 0.2 mm to 5.0 mm Al HVL (16 kVp to 90 kVp); Cable: 4.5 m (15 ft); Chamber dimensions: 4 cm Ø x 1.5 cm thick. This chamber meets the needs of the MQSA for an external transparent chamber. |
| **6000-530B** | 150 $cm^3$; Energy response: ± 10 % from 1.8 mm to 10 mm Al HVL; Cable: 3 m (10 ft); Chamber dimensions: 15.9 cm x 20.6 cm x 1.6 cm (6.26 in x 8 in x 0.63 in) |
| **6000-100** | 3.2 $cm^3$; Energy response: ± 5 % from 1 mm to 10 mm Al HVL; Cable: 0.9 m (3 ft); Sensitive length: 10 cm (4 in); Chamber inside Ø: 6.4 mm (0.25 in) |

### Optional accessories

**6000-528** Radiographic Ion Chamber
**6000-529** Mammographic Ion Chamber
**6000-100** CT Ion Chamber
**6000-530B** Image Intensifier Ion Chamber
**89-525** Carrying Case, holds RAD-CHECK Plus and accessories

### Ordering information

**06-526** RAD-CHECK Plus Dosimter
**06-526-2200** RAD-CHECK Plus Dosimeter, SI Units

FLUKE®
Biomedical

# 06-526-5240

## RAD-CHECK® MICRO-R

This state-of-the-art electrometer is designed for measuring dose and rate under high and low dose-rate conditions. It is excellent for cardiac cath and fluoroscopy and the perfect choice for tight budgets.

RAD-CHECK® MICRO-R technology gives you the ability to measure dose and rate in fluoroscopy with the accuracy and reliability of equipment that costs two or three times more.

With the RAD-CHECK MICRO-R, measurements are easy to perform and highly accurate. Incorporate RAD-CHECK MICRO-R into your routine QC program for fluoroscopy now, and accurately measure what your patient exposures actually are from fluoroscopically-guided procedures. This precision electrometer also features a tiltstand for convenient adjustment of display visibility.

### Key features

- Entrance skin exposure measurements (ESE)
- Fluoroscopy exposure examinations
- Exposure checks; radiographic (mR/mAs)
- Beam quality; half value layer (HVL)
- mAs reciprocity; mA station checks, plus many others depending on the remote external chambers used
- The American College of Radiology (ACR) recommends this type of product in their quality-assurance program
- Fast and easy use
- Dual-range for high and low dose-rate fluoroscopy
- Optimized for use with our 100 $cm^3$ Image Intensifier Ion Chamber (06-524-3000)
- Portable, no ac power cords

## Specifications

| | |
|---|---|
| **Ranges** | Low: 0.01 mR to 19.99 mR; 0.1 R/min to 199.9 R/min |
| | High: 0.01 R to 19.99 R; 0.1 R/min to 1999 R/min |
| **Standard calibration** | At 75 kVp with 4 mm Al filtration at 22 °C and one atmosphere using 06-524-3000 chamber |
| **Reproducibility** | Within 2 % short-term over 100 mR to 2 R range (1 mGy to 20 mGy) |
| **Maximum exposure rate** | Minimum 90 % collection at 20 R/sec |
| **Electrometer drift** | Low range: 1 mR/min typical; 6 mR/min maximum |
| | High range: 10 µR/min typical; 60 µR/min maximum |
| **Manual reset** | Resets display to zero |
| **Operating temperature** | 10 °C to 40 °C (50 °F to 104 °F) |
| **Relative humidity** | 0 % to 90 % |
| **Display** | 3.5 in x 0.5 in LCD, low battery indicator |
| **Control** | Reset button, dose or dose rate output selector, high or low range selector, on/off switch |
| **Power requirements** | 9 V alkaline battery, > 50 hour life |
| **Dimensions** (WxDxH) | 15.25 cm x 6.25 cm x 7 cm (6 in x 6.25 in x 2.75 in) |
| **Weight** | 0.51 kg (1.125 lb) |

### Optional accessories

**89-525** Carrying Case: holds RAD-CHECK MICRO-R and accessories

### Ordering information

**06-526-5240** RAD-CHECK MICRO-R
*(Must have 06-524-3000 chamber and must be calibrated at the same time)*

# 07-494, 07-492 and 07-479

## Wide-Range, Mammographic, and Dental Digital kVp Meters

FLUKE® Biomedical

Whether using the Wide-Range, Mammographic, or the Dental Digital kVp Meter, these devices offer quick and accurate measurements of diagnostic x-ray generator tube potential. These instruments need no connection to the x-ray generator.

Lightweight and rugged, these meters are extremely easy to use. Simply place on the x-ray table with the detector facing the x-ray source. With the beam's central ray centered on the detector, an exposure is made and the reading appears immediately on the large, easy-to-read liquid crystal display.

Unique features are provided to ensure maximum efficiency and accuracy. Readings remain on display until the next exposure is made, at which time the reading is automatically updated. Automatic display indicators tell you when adjustment of exposure factors or battery replacement is necessary. Neither remote-control cables nor time-consuming manual re-zeroing are needed.

A BNC connector is provided for radiation waveform display on a storage oscilloscope.

### Key features

- Choose from three kVp meters
- Easy-to-read digital display
- Fast and easy setup
- Automatic display reset
- No remote-control cables
- Scope output for waveform analysis
- Compact, lightweight and battery-operated

## Specifications

| | |
|---|---|
| **Ranges** | Wide range<br>Low: 50 kVp to 90 kVp, 0.1 kVp resolution<br>High: 80 kVp to 150 kVp, 0.1 kVp resolution |
| | Mammographic: 24 kVp to 40 kVp, 0.1 kVp resolution |
| | Dental: 45 kVp to 90 kVp, 0.1 kVp resolution |
| **Accuracy** | Wide range: ± 3 % or 3 kVp (whichever is greater) |
| | Mammographic: ± 3 % or 1.5 kVp (whichever is greater) |
| | Dental: ± 3 % or 3 kVp (whichever is greater) |
| **mAs requirements** | Wide range: (45.7 cm SDD) 18 mAs at 120 kVp; 50 mAs at 60 kVp, single phase. Minimum exposure time 1/20 (0.05) sec |
| | Mammographic: (25 cm SDD) 100 mAs at 24 kVp. Minimum exposure time 1/20 (0.05) sec |
| | Dental: 8.5 mAs at 45 kVp; 0.026 mAs at 90 kVp |
| **Controls** | Wide range: On/off, single/three-phase and range selection switch |
| | Mammographic: On/off and Moly/Tungsten selector switches |
| | Dental: On/off and single/three-phase selector switches |
| **Operating temperature** | 10 °C to 40 °C (50 °F to 104 °F) |
| **Relative humidity** | 0 % to 90 %, non-condensing |
| **Power requirements** | 9 V alkaline battery, 150 hours operation |
| **Display** | 3.5 in x 0.5 in LCD. Automatic indication of (a) low battery condition, (b) need to adjust exposure factors |
| **Output signal** | BNC connector for waveform analysis |
| **Dimensions** (WxDxH) | 20 cm x 15 cm x 6 cm (8 in x 6 in x 2.5 in) |
| **Weight** | 0.9 kg (2 lb) |

### Optional accessories

**89-473** Carrying Case

### Ordering information

**07-494** Wide-Range Digital kVp Meter
**07-492** Mammographic Digital kVp Meter
**07-479** Dental Digital kVp Meter

# 18-526 Series

## Service and Quality Control Kits

FLUKE® Biomedical

**18-526-3000 Cardiac Cath/ Special Procedures QC Kit**
Contains the essential non-invasive test tools for special procedures.

**18-526-1000 Mammography QC Kit**
Everything you need to make compliance with ACR and MQSA regulations easy.

**18-526-2000 Radiography/ Fluoroscopy QC Kit**
All the test devices necessary to perform QC in radiographic and fluoroscopic suites.

**18-526-4000 Dental QC Kit**
Service and QC are easier and more cost effective than ever with this comprehensive kit.

### Key features

- Each kit contains the essential instruments that service personnel, physicists, and QC technicians rely on to check and calibrate today's most vital equipment
- Every instrument selected for inclusion in our Service/QC kits was selected for reliability, accuracy, and ease of use
- Each Service/QC kit includes an easy-to-carry, durable, insulated carrying/storage case to keep your equipment safe wherever you go
- Optional mAs meter available

### Included accessories

**89-426** Carrying Case

**18-526-3000**
**06-526-5240** RAD-CHECK® MICRO-R
**07-494** Wide-Range Digital kVp Meter
**07-453** Digital X-Ray Pulse Counter/Timer
**06-524-3000** Image Intensifier Ionization Chamber, 100 $cm^3$

**18-526-1000**
**06-526** RAD-CHECK PLUS
**07-492** Mammographic Digital kVp Meter
**07-453** Digital X-Ray Pulse-Counter/Timer
**6000-529** Mammographic Ion Chamber, 3.3 $cm^3$

**18-526-2000**
**06-526** RAD-CHECK PLUS
**07-494** Wide-Range Digital kVp Meter
**07-453** Digital X-Ray Pulse-Counter/Timer
**6000-528** Radiographic Ion Chamber, 30 $cm^3$

**18-526-4000**
**06-526** RAD-CHECK PLUS
**07-479** Dental Digital kVp Meter
**07-453** Digital X-Ray Pulse-Counter/Timer
**07-453-2000** Remote Sensor for use with 07-453
**6000-528** Radiographic Ion Chamber, 30 $cm^3$

### Ordering information

**18-526-3000** Cardiac Cath/ Special Procedures QC Kit
**18-526-1000** Mammography QC Kit
**18-526-2000** Radiography/ Fluoroscopy QC Kit
**18-526-4000** Dental QC Kit

# 07-453

## Digital X-Ray Pulse Counter/Timer

Poor or inconsistent quality of x-ray images is caused by an inaccurate generator timer. This results in repeat examinations, which cost time and money. A poorly maintained system is also hazardous to the patient. When a malfunction in the timer occurs, the patient may receive unnecessary radiation doses. Regular monitoring of x-ray systems and timers is an essential part of a good quality-assurance program.

07-453 Digital X-Ray Pulse Counter/Timer is a non-invasive, solid-state instrument to measure the exposure time of either ac or dc x-rays as well as the duration of radiation output produced by a wide variety of medical and dental x-ray systems. A sensitive x-ray detector in the instrument allows direct measurement of exposure from the x-ray head. Pulses produced by half-wave and full-wave x-rays are measured as 60 or 120 pulses per second. For dc, capacitor discharge and three-phase x-rays, 07-453 measures the exposure time in milliseconds. When testing x-ray timers and controls, the time of relay contact closure is measured using the ac input feature.

An output connector on the side of 07-453 allows the user to view a radiation output waveform on an oscilloscope to diagnose and troubleshoot problems with x-ray generators.

### Key features

- Measures duration of radiation output produced by x-ray generators
- Measures ac or dc x-rays
- Gives direct readings (time or pulses)
- Can be used for medical or dental x-ray systems
- Designed specifically to allow service personnel to accurately and easily assess the performance of x-ray generators, timers, and controls
- Saves time and money by reducing repeat examinations
- Easy-to-read digital display
- Automatic reset; holds a reading until the next exposure
- Battery-operated, lightweight; fits easily into tool box or pocket
- Output connector (included) allows a radiation output waveform to be viewed on an oscilloscope
- For added operator convenience, the remote sensor is available as an option
- The optional remote sensor can be used when the user has the unit in their hand. The remote sensor can also be used when placement of the Digital X-Ray Pulse Counter/Timer in the beam is questionable, such as in a Panorex dental x-ray unit

## Specifications

| | |
|---|---|
| **Accuracy** | AC input ± 1 count, dc input 2 %, ± 1 count, X-ray detection ± 1 count |
| **Sensitivity** | AC input: 90 V ac minimum |
| | X-ray input: 50 kVp, 5 mA at 5 cm from top surface of case, pointed to target on case |
| **Range** | 9999 pulses; 9999 ms |
| **Display** | 0.3 inch liquid crystal |
| **Power requirements** | 9 V battery, alkaline or equivalent, 48 hours minimum; typically six months of normal use |
| **AC input jacks** | 130 V ac maximum; 90 V ac minimum; input circuit not affected by reversed polarity |
| **Output signal** | BNC connector for waveform analysis |
| **Connections** | None required for direct exposure measurement |
| **Controls/indicators** | Three-position switch: Pulse, Off, Milliseconds |
| | Four-digit LCD (0.4 in character) |
| | Low battery indicator |
| | "Low Batt" appears in display when battery voltage reaches 5.3 V ± 0.3 V |
| | Power-on: LED (green); oscilloscope output |
| **Dimensions** (LxWxH) | 14.7 cm x 8 cm x 4 cm (5.8 in x 3.15 in x 1.6 in) |
| **Weight** | 0.21 kg (0.5 lb) |

### Optional accessories

**07-453-2000** Remote Sensor with 10 ft cable
**88-453** Oscilloscope Leads
**89-453** Carrying Case

### Ordering information

**07-453** Digital X-Ray Pulse Counter Timer

FLUKE®
Biomedical

# 07-487

## Dual-Range Digital mAs Meter

The 07-487 Dual-Range Digital mAs Meter allows service personnel to check and adjust the mA settings of x-ray generators. This easy-to-use instrument is calibrated directly in mAs, thus eliminating the need for the calculations typically required with more complicated and expensive equipment.

The digital mAs meter is very sensitive. It can measure increments of 0.1 mAs. It has a low range of 0 mAs to 199.9 mAs; push a button and the range expands to 0 mAs to 1999 mAs.

The greatest use for the 07-487 mAs meter is in calibrating the high-current, short-time station where a conventional mAs meter is precluded by tube ratings. The instrument can be used (after verifying the generator accuracy) to set all mA stations and check that phototiming error does not exceed the limits of good practice. To use, simply connect the cable to the x-ray generator and make the required exposure. The mAs reading appears instantaneously on the four-digit LCD. A display indicator warns of the need for battery replacement.

CE

### Key features

- Accurately measure x-ray generator mAs values
- Meets today's QC needs for accuracy and dependability
- Used for calibration of high current and phototimer accuracy
- Calibrated directly in mAs; no calculations required
- Handheld, battery-operated, and lightweight

## Specifications

| | |
|---|---|
| **Ranges** | 0 mAs to 199.9 mAs ("+" overrange indicator above 160 mAs). Also 0 mAs to 1999 mAs ("+" overrange indicator above 1600 mAs) |
| **Accuracy** | ± 2 % of reading |
| **Input** | 25 mA to 1000 mA |
| **Drift** | Zero |
| **Operating temperature** | 15 °C to 30 °C (50 °F to 100 °F) |
| **Controls** | POWER (on/off), RANGE (highlow), and RESET |
| **Power requirements** | Single 9 V alkaline battery; typical life 80 hours |
| **Input jack** | Uses two banana jacks |
| **Dimensions** (WxDxH) | 8.9 cm x 16.8 cm x 3.5 cm (3.50 in x 6.63 in x 1.38 in) |
| **Weight** | 0.2 kg (0.44 lb) |

### Included accessories

**177002** 24 inch Cable with banana plugs and insulated alligator clips on opposite ends

### Ordering information

**07-487** Dual-Range Digital mAs Meter

FLUKE®
Biomedical

# 07-469

## Wave Precision High-Voltage Divider

07-469 Wave Precision High-Voltage Divider provides two ranges that allows it to be used with a variety of readout devices. One range of 07-469 is 10,000:1, when operated into a 1 MΩ load, such as the direct input of an oscilloscope. The other mode of operation provides the 1000:1 ratio into a 10 MΩ load. In this mode, it can be used as a replacement for the GE divider when connected in a similar manner. It can also be connected to 10 MΩ input impedance dc digital voltmeters or 10 M 10 X scope probes. The three anode connections are individually wired for use on the latest GE CT Scanners.

07-469 is designed with the same dc resistance values as the General Electric C1515A and 46-15496681. Those voltage dividers have a frequency response valid to 1000 Hz. 07-469 performs as a frequency-compensated replacement for those dividers and is usable at high frequencies as well as short exposures. With a well-characterized rise time, 07-469 is suitable for use in radiographic, cine, pulsed, and mammographic applications.

### Key features

- Replacement for GE divider
- Can be used with oscilloscopes or dc digital voltmeters
- Three individually-wired anode connectors for use with the latest GE CT scanners

## Specifications

| | |
|---|---|
| **DC accuracy when operated into rated load impedance** | 1 % |
| **Divider ratio** | Switch selectable 10,000:1 or 1,000:1 |
| **Divider resistance** | 100 megohm |
| **Load impedance** | 1 megohm @ 10,000:1 or 10 megohm @ 1,000:1 |
| **Voltage range** | 0 kVp to 150 kVp |
| **DC accuracy** | 1 % or better, 10 kV to 75 kV per side |
| **Frequency response** | DC to 1 kHz ± 3 %, to 100 kHz ± 5 % |
| **Insulation** | Oil filled, may be operated continuously |
| **HV terminals** | Federal standard 3 pin. 4 pin optional for cathode |
| **Output terminals** | BNC. Oil tight selector switch |
| **Dimensions** (LxH) | 25 cm x 30.5 cm (10 in x 12 in) |
| **Weight** | 14.5 kg (32 lb) |

### Optional accessories

**87-476** Carrying Case
**07-478** High-Voltage Cable, 5 ft

### Ordering information

**07-469** Wave Precision High-Voltage Divider, without cables
**07-469-4780** The Wave Precision High-Voltage Divider, with two cables

FLUKE®
Biomedical

# 18-116

## VeriLUM® Color Dual Mode Pod 5.2

VeriLUM is an innovative tool for ensuring consistent display monitor performance. It provides an easy and efficient way to judge whether a display system is continuing to function normally or needs adjustment or replacement.

VeriLUM can be used for acceptance testing of a CRT or LCD display system.

It also provides a quick visual check for the user. A SMPTE test pattern is displayed on each monitor. If the gray scale range and stability is adequate and if all the monitors have essentially the same look and feel, then the display system is ready for use. Bitmaps, DICOM® images (e.g. AAPM TG-18) can be displayed.

VeriLUM makes a rapid set of measurements of the display luminance for tracking consistent performance over time. These measurements take less than 30 seconds per monitor and the history chart can be printed when hard-copy documentation is needed.

VeriLUM can be used to perform gamma correction in conformance with the DICOM Part 14 Grayscale Standard Display Function or any other user-defined luminance response model. VeriLUM provides on-board gamma correction using BARCO/Metheus, DOME, Image Systems, Matrox, and RealVision gray scale video boards. If the operating system is Microsoft Windows® 2000, XP®, ME®, or Vista and if the color video card supports downloadable gamma ramps, then VeriLUM will use that capability.

VeriLUM software can be installed on as many workstations as desired; no additional licenses are required. This allows the VeriLUM luminance pod to be taken from workstation to workstation to perform measurements. The VeriLUM luminance pod supports all CRTs and all LCD panels. It uses a USB port on the PC, thus a simple extension cable (provided) allows for simple connection.

### Key features

- A quality control tool for ensuring consistent color and grayscale video display performance
- Can be used for acceptance testing
- Calibrates luminance to conform with DICOM Part 14 Grayscale Standard Display Function
- Supports Microsoft® Windows 2000, XP, and Vista operating systems
- Each VeriLUM package includes: pod and cd-rom with version 5.2 software and user guide
- Applicable to CRT and LCD displays

## Specifications

| | |
|---|---|
| **Minimum computer requirements** | Intel® PC, CD-Rom, Microsoft Windows 2000, Vista, and a video board capable of 1024 x 768 pixels with a minimum of 256 colors or a grayscale video board |
| **Calibration** | Traceable to a NIST source |
| **Luminance accuracy** | ± 2 % |
| **Luminance repeatability** | ± 1 % |
| **Luminance range** | 0.05 cd/sqm to 1000 cd/sqm |
| **Weight** | 0.45 kg (1 lb) |

### Ordering information

**18-116** VeriLUM Color Dual Mode Pod

*Complies with European restrictions on hazardous substances (RoHS).*

*(please specify serial or USB connector)*

# 07-621

## Precision Photometer

FLUKE® Biomedical

Photometers are required for medical, scientific, and laboratory applications. The 07-621 Precision Photometer utilizes a filtered sensor with spectral response tightly calibrated to the CIE photopic response. The illuminance receptors closely follow the Cosine Law relative sensitivity versus angle of illuminance.

The 07-621 is a highly accurate instrument designed to measure both illuminance (the amount of light falling on a surface) in lux (lumens per $m^2$) and luminance (the amount of light emitted from a surface) in nit (candela per $m^2$).

CE

The 07-621 easily and quickly verifies that an x-ray collimator light and/or CT system light source used for patient alignment and localization is in accordance with regulations and guidelines. It also measures the brightness and uniformity of an x-ray view box, quickly detecting non-uniformity (which may appear as artifacts, causing misdiagnosis). This battery-operated photometer has a bright LED display and only two operating controls: "Measure" for taking a reading and "Range" to adjust the meter display to the light level being measured.

### Key features

- The luminance of view boxes for interpretation or QC of mammography images meets or exceeds minimum levels
- Ambient illuminance levels are below prescribed levels
- Viewing conditions have been optimized
- NIST-traceable
- Performs required ACR (NITS) measurements
- Easy to read digital display
- Small, convenient to carry and supplied with its own carrying case
- Rugged construction
- Measure button: press it to get continuously updated readings. Releasing the measure button freezes the last reading for convenient reference
- Range button: adjusts the measurement display for the resolution desired
- LED display: visible in very dim light, as well as direct sunlight. LED displays are inherently robust in comparison to liquid crystal displays (LCDs)
- The battery-powered photometer provides tens of thousands of readings

## Specifications

| | |
|---|---|
| **Capabilities** | Illuminance measured in lux (foot-candles); or luminance measured in candela/m2 (nit) |
| **Readout display** | Three-digit LED, 0.25 in high |
| **Range** | 0.1 to 999,000 lux or nits (candela/m2), equivalent to 0.01 to 99,000 foot candles |
| **Accuracy** | Within 7 % of full scale range, for light sources between 2500° and 5400° Kelvin |
| **Electrical accuracy** | 1 % plus two digits |
| **Sensor** | Silicon photodiode with photometric filter |
| **Response curve shape** | Close match to CIE photopic response curve |
| **Power requirements** | Type A-76 alkaline button cells or silver oxide equivalents |
| **Dimensions** (WxDxH) | 7 cm x 3 cm x 10 cm (2.8 in x 1.2 in x 4 in) |
| **Weight** | 0.11 kg (0.25 lb) |

### Optional accessories

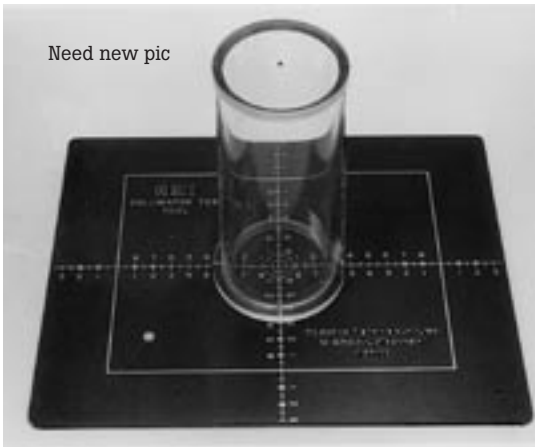
**07-634** Fiber-Optic Probe, Flexible 12 in (must be calibrated with meter)
**07-634-1000** Fiber-optic Probe, Rigid 1 inch (must be calibrated with meter)
**07-634-1100** Rotating Illuminance Receptor (must be calibrated with meter)
**89-621** Carrying Case

### Ordering information

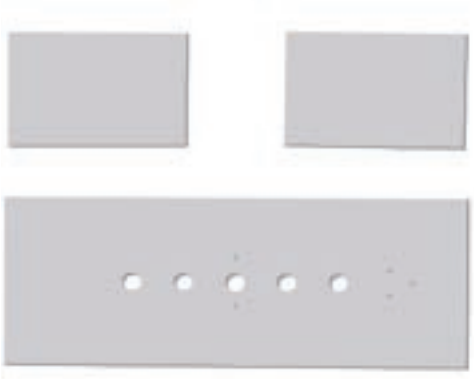
**07-621** Precision Photometer
**07-621-6341** Precision Photometer with rotating illuminance receptor
**07-621-6342** Precision Photometer with rigid 1 inch fiber-optic probe
**07-621-6343** Precision Photometer with flexible 12 inch fiber-optic probe
*Factory recalibration available*

# 07-661-7662 and 07-644

## Collimator/Beam Alignment Test Tool and Grid Alignment Test Tool




07-661-662 Collimator/Beam Alignment Test Tool



07-644 Grid Alignment Test Tool

### 07-661-7662 Collimator/ Beam Alignment Test Tool

In radiographic quality control, it is essential to verify proper alignment of the collimator light field with the x-ray field. The 07-661-7662 readily indicates a 1 % or 2 % misalignment at a 40 in focal-film distance (FFD), but it may be used at any FFD.

It consists of a flat 8 in x 10 in plate with a 14 cm x 18 cm pattern etched on its surface. It can also be used to check fluoroscopy alignment and collimation.

Improper central-ray alignment will distort a radiographic image. The 07-661-7662 provides a simple means of determining if the x-ray beam is perpendicular to the image receptor and centered with respect to the light field. A steel ball is mounted in the center of a disc at each end of the 15 cm high clear plastic cylinder. When the balls are positioned over one another and at a right angle to the film, their images will appear as one if the central ray is truly perpendicular to the film. The approximate degree of improper angulation can also be determined.

### Key features

**07-661-7662**

- Verifies proper alignment of collimator light field to x-ray field
- Verifies alignment of central ray is perpendicular to image receptor

**07-644**

- Checks focused grid alignment with relation to central ray
- Checks focused grid alignment to the center of a film cassette

### 07-644 Grid Alignment Test Tool

Increased patient radiation dose and reduced image contrast can result from lateral decentering or tilting of a focused grid used in a Bucky apparatus. The 07-644 Grid Alignment Test Tool is used to check whether a focused grid is aligned properly with the central ray and the center of the film cassette. The easy-to-use test tool is centered on the x-ray table and fixed in position perpendicular to the grid lines. Five exposures are made, with the x-ray beam sequentially centered on each of five holes, and the optical densities of the hole images are compared. A properly-centered and leveled grid will result in equal density changes in the hole images on either side of the central hole. Unequal density changes indicate the need for corrective action.

## Specifications

**07-661-7662**

| | |
|---|---|
| **Dimensions beam alignment** | 15 cm (h) x 006.3 OD cm (5.9 in x 2.5 in) |
| **Weight beam alignment** | 0.24 kg (0.54 lb) |
| **Weight collimator** | 0.19 kg (0.41 lb) |

**07-644**

| | |
|---|---|
| **Lead plates** | Three plastic-covered, 0.062 inch thick lead plates |
| | (1) 9.125 in x 3.625 in test plate |
| | (2) 3.56 in x 2.375 in blocker plates |
| **Test plate** | (5) 0.375 inch test holes and (5) 0.062 in orientation holes |
| **Weight** | 0.68 kg (01.5 lb) |

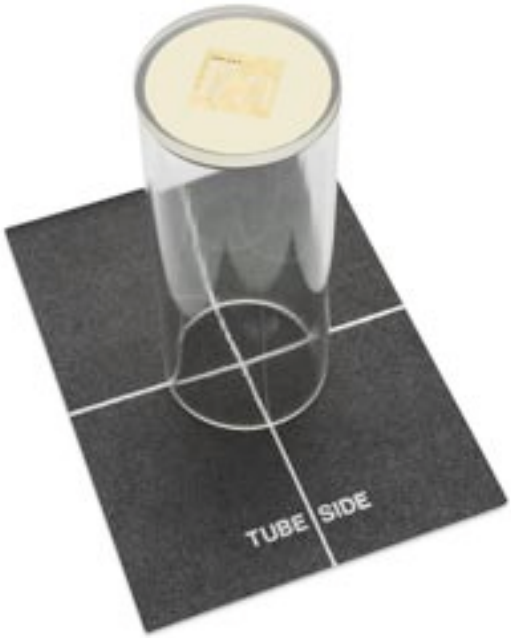
### Ordering information

**07-661-7662** Collimator/Beam Alignment Test Tool

**07-644** Grid Alignment Test Tool, including three lead plates

# 07-591

## Focal Spot Test Tool




The 07-591 Focal Spot Test Tool provides a simple pass-fail test to determine if an x-ray tube focal spot has been damaged. This tool consists of a 6-inch-high stand with a thirteen-group test pattern. Each group has six bars, three of which are positioned at right angles to the adjacent set. The groups diminish in size from 0.63 line pairs/mm (2 mm) to 2.52 line pairs/mm (0.8 mm). By observing the radiograph and using the supplied chart, showing resolution vs. focal spot size, the nominal focal spot dimension (in mm) can be determined.

### Optional accessories

**07-800-5007** Flex Film Cassette, 5 in x 7 in

## Specifications

| | |
|---|---|
| **Dimensions (stand)** (WxH) | 6.35 cm x 15.24 cm (2.50 in Ø x 6 in) |
| **Weight** | 0.11 kg (0.25 lb) |

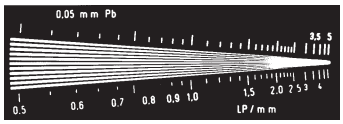
### Ordering information

**07-591** Focal Spot Test Tool

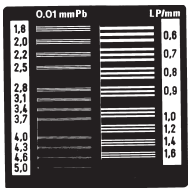
# 07-501 to 07-555

## Test Patterns

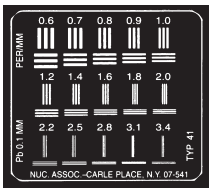
Shown in Model 07-501-2000



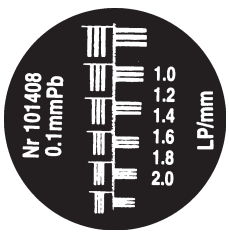
Shown in Model 07-523 1000/2000



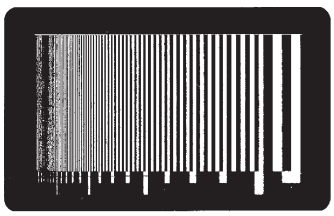
Shown in Model 07-527



Shown in Model 07-541-2000



Shown in Model 07-506


Shown in Model 07-553

**X-Ray Test Patterns for measuring resolution**
Fluke Biomedical offers a range of patterns for use in a variety of desired applications. The sector test patterns are 0.4°, and the group test patterns have varying numbers of line pair groups. Lead thicknesses are limited by the resolution, with a maximum thickness of 0.1 mm for test patterns up to 5 LP/mm. Radiopaque numbers indicate the resolution (in LP/mm) of each group.

## Specifications and ordering information

| Model | Range of resolution in LP/mm | Number of groups | Lead-foil thickness in mm | Dimensions in mm |
|---|---|---|---|---|
| **X-Ray Test Patterns for measuring resolution** | | | | |
| **07-501-2000** | 1.0 to 4.8 | 16 | 0.1 | 110 x 40 |
| **07-501-1000** | Ultra-High Precision Pattern (same specifications as 07-501-2000) | | | |
| **07-521** | 2.0 to 10.0 | 15 | 0.05 | 94 x 50 |
| **07-525** | 3.15 to 16.6 | 15 | 0.03 | 94 x 50 |
| **07-555** | 5.0 to 20.0 | 13 | 0.02* | 25 x 10 |
| **07-515** | 1.0 to 10.0 | 1 | 0.05 | 80 x 40 |
| **07-523-2000** | 0.5 to 5.0 | 1 | 0.1 | 157 x 50 |
| **07-523-1000** | Ultra-High Precision Pattern (same specifications as 07-523-2000) | | | |
| **07-539** | 1.5 to 20.0 | 1 | 0.025 | 60 x 30 |
| **07-526** | 0.6 to 10.0 | 26 | 0.05 | 65 x 55 |
| **07-527** | 0.6 to 5.0 | 20 | 0.01 | 50 x 50 |
| **07-535** | 0.6 to 5.0 | 20 | 0.05 | 50 x 50 |
| **07-538-2000** | 0.6 to 5.0 | 20 | 0.1 | 50 x 50 |
| **07-538-1000** | Ultra-High Precision Pattern (same specifications as 07-538-2000) | | | |
| **07-541-2000** | 0.6 to 3.4 | 2 x 15 | 0.1 | 50 x 50 |
| **07-541-1000** | Ultra-High Precision Pattern (same specifications as 07-541-2000) | | | |
| **07-548** | 2.0 to 6.0 | 2 x 14 | 0.08 | 50 x 50 |
| **X-Ray Test Patterns for measuring resolution of image intensifiers and video systems** | | | | |
| **07-506** | 1.0 to 2.0 | 2 x 6 | 0.1 | 32 |
| **07-507** | 3.0 to 4.0 | 2 x 6 | 0.1 | 32 |
| **07-511** | 2.0 to 3.0 | 2 x 6 | 0.1 | 32 |
| **07-519** | 1.8 to 3.15 | 2 x 6 | 0.1 | 32 |
| **07-529** | 2.8 to 5.0 | 2 x 6 | 0.1 | 32 |
| **07-532** | 5.0 to 6.0 | 2 x 6 | 0.05 | 32 |
| **07-537** | 5.0 to 7.0 | 2 x 6 | 0.05 | 32 |
| **07-526** | 0.6 to 10.0 | 26 | 0.05 | 65 x 55 |

**Ultra-High Precision Test Pattern for measuring modulation transfer function**
The Ultra-High Precision Test Pattern utilizes 22 groups of line pairs. Each group is indicated by the extended line above the pattern. The resolution of the individual groups can be taken from the table. Lead thickness is 0.05 mm. Pattern size is 71 mm x 44 mm.

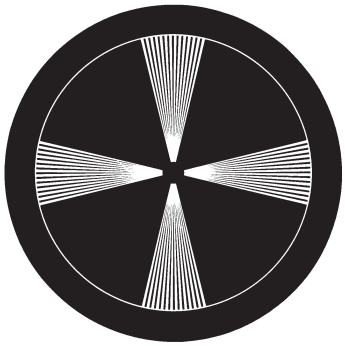
| Group | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **LP/mm** | 0.25 | 0.5 | 0.6 | 0.7 | 0.85 | 1 | 1.2 | 1.4 | 1.7 | 2.0 | 2.4 |
| **Group** | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| **LP/mm** | 2.9 | 3.5 | 4.2 | 5 | 6 | 7 | 8.5 | 10 | 8.5 | 7 | 6 |

### Ordering information
**07-553** Ultra-High Precision Test Pattern

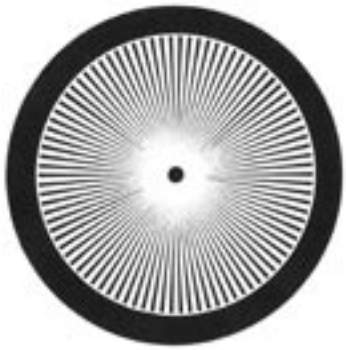
# 07-503 to 07-551, 07-456

## Star Patterns
## High-Purity Aluminum Step Wedges

FLUKE® Biomedical



Shown in 07-509-2000



Shown in 07-509-2000

**Star x-ray test patterns**

Focal spot size can be determined by observing the regions of blurring which occur when the pattern is radiographed by an x-ray source of finite dimensions. Radiation from different areas of the focal spot will cause a periodic blurring of the pattern due to penumbra effects. Knowledge of the geometric factors, and the distance from the center of the pattern to the region where blurring occurs, will permit the calculation of the focal spot size with the same accuracy as measurements made with a pinhole camera.

**07-456 High-Purity Aluminum Step Wedges**

- Built to US Federal specification GG-X-635C
- Determines mAs linearity
- Determines contrast vs. kVp
- Used for:
  - Darkroom fog testing
  - Film and screen comparison
  - Technique chart development

On these high-purity aluminum step wedges, even-numbered steps are identified with lead numerals.

## Specifications

| | |
|---|---|
| **07-503-2000**<br>**07-503-1000**<br>**07-550**<br>**07-551** | Dimension: 55 mm Ø<br>For measuring focal spots from 0.1 mm to 0.3 mm<br>Sectors: (4) 15° patterned sectors with a 0.5° angle of a single line within a sector<br>Sectors (07-550): (4) 45° patterned sectors, for easier interpretation<br>Sectors (07-551): (4) 15° patterned sectors with a 0.25° angle<br>Thickness: Lead-foil thickness 0.03 mm |
| **07-509-2000**<br>**07-509-1000** | Dimension: 55 mm Ø<br>For measuring focal spots from 1 mm and up<br>Sectors: (4) 45° sectors with a 2° angle of a single line within a sector<br>Thickness: Lead-foil thickness 0.05 mm |
| **07-542-2000**<br>**07-542-1000** | Dimension: 55 mm Ø<br>For measuring focal spots from 0.3 mm to 0.6 mm<br>Sectors: (4) 28° patterned sectors with a 1° angle of a single line within a sector<br>Thickness: Lead-foil thickness 0.03 mm |
| **07-543-2000**<br>**07-543-1000** | Dimension: 55 mm Ø<br>For measuring focal spots from 0.8 mm to 1.5 mm<br>Sectors: (4) 35° patterned sections with a 1.5° angle of a single line within a sector<br>Thickness: Lead-foil thickness 0.03 mm |
| **07-510-2000**<br>**07-510-1000** | Dimension: 55 mm Ø<br>For measuring focal spots from 1 mm and up<br>Sectors: (1) 35° 360° pattern sector with a 2° angle of a single line within a sector<br>Thickness: Lead-foil thickness 0.05 mm |

07-456 High-Purity Aluminum Step Wedges

**07-456**

| | |
|---|---|
| **11 steps** | |
| **Dimensions** | Step wedge: 2.5 in x 5.5 in x 1.375 in<br>Each step: 0.5 in surface; 3 mm rise |
| **Weight** | 0.50 kg (1.10 lb) |
| **21 steps** | |
| **Dimensions** | Step wedge: 3 in x 10.3 in x 1.85 in<br>Each step: 12 mm surface; 2.1 mm rise |
| **Weight** | 1.45 kg (3.20 lb) |

### Ordering information

**07-503-2000** High-Precision Star X-Ray Test Pattern
**07-503-1000** Ultra-High Precision Star X-Ray Test Pattern
**07-509-2000** High-Precision Star X-Ray Test Pattern
**07-509-1000** Ultra-High Precision Star X-Ray Test Pattern
**07-542-2000** Precision Star X-Ray Test Pattern
**07-542-1000** Ultra-High Precision Star X-Ray Test Pattern
**07-543-2000** High-Precision Star X-Ray Test Pattern
**07-543-1000** Ultra-High Precision Star X-Ray Patterns
**07-550** Ultra-High Precision Star X-Ray Patterns
**07-551** Ultra-High Precision Star X-Ray Pattern
**07-510-2000** High-Precision Star X-Ray Test Pattern
**07-510-1000** Ultra-High Precision Star X-Ray Test Pattern
**07-456** 11 Step Wedge, Type-2024 Aluminum
**07-456-1100** 11 Step Wedge, Type-1100 Aluminum
**07-456-2100** 21 Step Wedge, Type-2024 Aluminum
**07-456-2111** 21 Step Wedge, Type-1100 Aluminum

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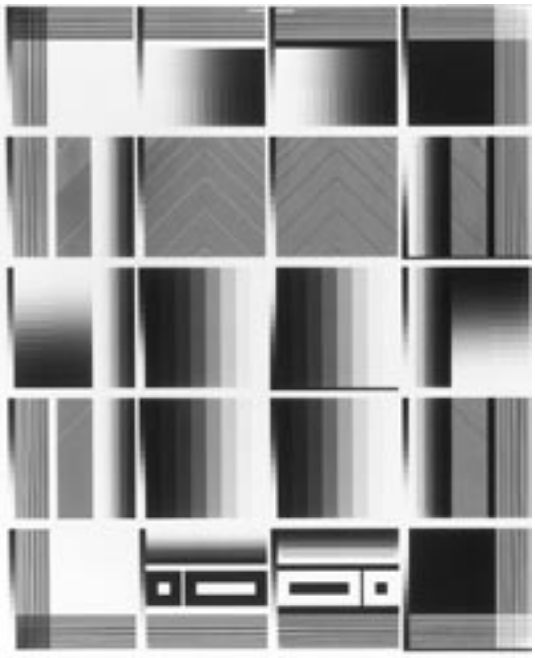
Biomedical

# 07-450

## PACS Test Patterns in Digital Format



The 07-450 PACS/Teleradiology Test Pattern is superior to the SMPTE Test Pattern for PACS/Teleradiology quality control. It provides a simple, objective approach to system evaluation, allowing for quick, objective testing of image quality by a single observer. Simply digitize the PACS Test Pattern by loading the test image from the disk and display it at full resolution on your display monitor. Then, using your systems controls, magnify and view different areas of the test pattern.

A regular quality control procedure is mandatory to ensure a diagnostic level of image quality with PACS and teleradiology. A quick, objective and reproducible QC test is needed to ensure optimization of the digitizer and display system.

As an integral part of your regular QC for a laser scanner or CCD digitizer, the digital format PACS Test Pattern will prove itself as an invaluable QC tool for testing image display systems and film printers.

**The PACS/Teleradiology Test Pattern tests:**

- The ability to discriminate between 16 different gray scale levels from its lowest to its highest optical density, which is a greater number of gray scale levels than is tested by the SMPTE Test Pattern.
- For low-contrast discrimination with a rose-hole-type pattern which is not available on the SMPTE Pattern.
- The ability to discriminate between different gray levels on both sides of the pattern, as well as in the center of the pattern. These features, designed specifically for QC in teleradiology systems, provide a more superior test of gray scale reproduction than the SMPTE Pattern.
- High-contrast resolution in horizontal, vertical and diagonal axes, while the SMPTE Pattern test only horizontal and vertical axes.
- For specific artifacts which are important to digitization of radiographs, such as the ability to reproduce fine lines, blooming from bright areas, and light-leakage along the sides of the image.

### Key features

- High contrast resolution
- Low contrast discrimination
- Linearity of gray scale response
- Geometric distortion
- Reproduction of continuous fine lines
- Digitizer noise

"A teleradiology/PACS quality control test pattern may help identify problems that should be addressed to optimize printer quality. Regular interval testing of paper printers with a dedicated test pattern should be recommended as a part of the quality control program for all teleradiology/PACS systems."*

*A.D. Maidment, Ph.D; M, Albert, Ph.D; and E.J. Halpern, M.D., "A Quality Control Program for Paper Printers Used with Teleradiology/PACS," Radiology, 205 (P) (November 1997), 307.

## Specifications

| | |
|---|---|
| **Horizontal, vertical, and diagonal high contrast line Pairs** | Tests resolution up to 6 lp/mm when printed on 14 in x 17 in film |
| **Gray scale** | Tests full range of your printer or display |
| **Low contrast pattern** | Digital values of low contrast squares differ from the background density by 9 % |
| **Weight** | < 1 lb |

### Ordering information

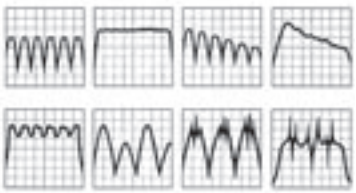
**07-450-1024** PACS Digital Test Pattern (1024 x 768)
**07-450-4000** PACS Digital Test Pattern (4 x 4 K)

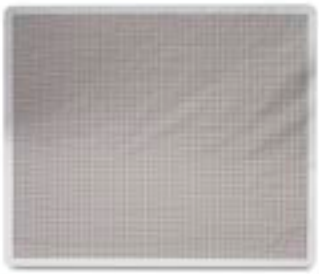
# 07-451, 07-608 and 07-706

## X-Ray Output Detector, Screen/Film Contact Mesh, and Phantom/Penetrometer System

FLUKE® Biomedical

07-451





07-608

07-706

### 07-451 X-Ray Output Detector

The 07-451 X-Ray Output Detector offers a dynamic means of demonstrating x-ray generator performance. It is used with a storage or camera oscilloscope to display the intensity-time relationship of an x-ray beam. To use, the detector is placed in the x-ray beam, and the output cable is connected to the oscilloscope input. The resulting waveshape patterns are used to calibrate and/or diagnose malfunctions in the x-ray generator.

The detector supplies a crisp 200 mV signal at standard diagnostic conditions (80 kVp, 100 mA). This extremely high output permits the simple interpretation of oscilloscope displays. Since the detector rise time is better than 1 ms, no alteration of the true x-ray output pulse shape is introduced.

### 07-608 Screen/Film Contact Mesh

The 07-608 Film/Screen Contact Mesh test tool determines the clarity of the focused image. This device allows problems to be identified so that image clarity can be restored. It consists of a 35.6 cm x 43 cm (14 in x 17 in) copper screen, with 0.3 cm (0.125 in) mesh, embedded in durable plastic for long life use. To use, simply lay the unit over the cassette, radiograph, and develop the film. Look for screen image clarity across the film. Blurring or distortion indicates poor film/screen contact.

### 07-706 Patient Phantom/Penetrometer System

To check the tabletop output of image-intensified fluoroscopic equipment properly, a simulated body or phantom should be placed between the x-ray output meter and the input phosphor. The 07-706 phantom protects the phosphor from the direct beam and provides the simulated attenuation needed to check the performance of image-intensifier systems. A penetrometer permits the determination of system contrast gradient under simulated operating conditions.

### Key features

- Timer calibration (single-phase, three-phase or CP units)
- Loading characteristics
- Rectifier malfunctions
- Contactor problems
- Cable or connector arcing
- Shutter calibration, etc.

### Optional accessories

**07-451**

**88-222** Cable, 6 m (20 ft), BNC to BNC

**07-706**

**07-629-1000** Aluminum Blocks, two Type-1100 Al 7.125 in x 7.125 in x 0.75 in thick

### Included accessories

**07-706**

(a) Two 7 in x 7 in x 0.75 in blocks of high-purity aluminum, which represent the equivalent absorption of 26 cm of water and simulate a thick or heavy-set patient at 90 kVp. A single block is the equivalent of a child or adult chest. Aluminum simulates the scatter characteristics of the human body.
(b) One 7 in x 7 in x 0.125 in lead beam-stop plate. When placed in the beam, this plate allows automatic brightness-control machines to deliver maximum output.
(c) One 7 in x 7 in x 0.03125 in aluminum penetrometer plate with 0.25 in, 0.176 in, 0.125 in, 0.088 in, and 0.0625 in holes. Place this plate between the two aluminum blocks and ascertain the contrast gradient of the penetrometer on image-amplified systems.
(d) Two sets of legs: one 1.25 in long and one 10.375 in long.

### Ordering information

**07-451** X-Ray Output Detector, includes BNC Output Connector

**07-706** Patient Phantom/Penetrometer System

**07-608** Screen/Film Contact Mesh

## Specifications

**07-451: Shock-resistant, solid-state diode detector**

| | |
|---|---|
| **Power source** | None required |
| **Rise time** | Less than 1 µsec |
| **Dimensions** (WxDxH) | 3.175 cm x 3.175 cm x 1.27 cm (1.25 in x 1.25 in x 0.5 in) |
| **Weight** | 16.6 g (0.58 oz) |

**07-706**

| | |
|---|---|
| **Dimensions** (WxDxH) | 17.8 cm x 17.8 cm x 4.2 cm (7 in x 7 in x 1.656 in) |
| **Weight** | 4.3 kg (9.5 lb) |

FLUKE®
Biomedical

# 07-894

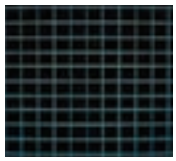
## Computer Monitor Tester

The 07-894 is an easy-to-use, portable instrument for testing, repairing and aligning analog computer monitors, LCD displays and video projection systems. A microprocessor and programmable logic-based design provide significant performance improvement over the common memory-based monitor testers. The 07-894 Computer Monitor Tester provides up to one hundred scan formats, including all current Video Electronics Standards Association (VESA) standards and most fixed frequency monitor scan formats. Additionally, the 07-894 is field-upgradeable to custom frequencies. Four video patterns (full raster, color bars, gray scale and dotted cross hatch) with 16 colors and intensity control provide all the patterns and colors normally required to test and align any monitor.

Use the 07-894 to cut repair time and reduce equipment downtime. Battery power enables you to repair monitors at the job site, eliminating the need to disconnect the monitor and transport it to another location for testing. Projectors can be aligned onsite, without the host workstation being present.

Color bars

Gray scale


Cross hatch

Full raster

### Key features

- Fully featured bench-top design
- Up to one hundred scan formats are available
- Allows for quick, easy troubleshooting, testing, and alignment of computer monitors
- Push-button operation including last setting memory
- Four video output connections for direct connection to PC, SUN, MAC and BNC monitors
- Features convenient VGA, MAC and SUN groupings of commonly used scan formats
- Selectable sync outputs for composite, sync-on green, and horizontal and vertical
- Selectable polarity settings for horizontal and vertical sync outputs
- Optional 10-minute timeout on video to prevent CRT burn-in
- Four video patterns with 16 colors and intensity control provided

## Specifications

| | |
|---|---|
| **Dimensions** (WxDxH) | 20.3 cm x 17 cm x 7 cm (8 in x 6.6 in x 2.7 in) |
| **Patterns** | The four video patterns with 16 colors and intensity control provide all the patterns and colors normally required to test and align any monitor. |
| **Power supply** | 9 V dc 500 mA wall transformer or six "C" cell alkaline batteries |
| **Compatibility** | Over 100 frequencies cover a wide range of monitors, including all industry standard PC, MAC and SUN frequencies. |
| **Connectors** | VGA (15 pin HD female) |
| | MAC II (15 pin D female) |
| | SUN (13W3 D female) |
| | RGHHV for BNC (5) |

### Ordering information

**07-894** Computer Monitor Tester

# 07-622, 07-623, and 07-533

## Multipurpose Test Stand, Mammography Test Stand, and Radiopaque Rulers

FLUKE® Biomedical

07-622

### 07-622 Multipurpose Focal Spot/HVL Test Stand

The 07-622 Multipurpose Focal Spot/HVL Test Stand* can be used for half-value layer measurements and features extendible legs that provide the enlargement factors required by the NEMA® standard. It's designed for both over-table and under-table x-ray tube measurements. Long leveling screws allow the positioning of a screen-film cassette under the base.

### 07-623 Mammography Focal Spot Test Stand

It is particularly important to verify the size of the focal spot during acceptance testing of new mammographic equipment or when a new x-ray tube is installed. The 07-623 Mammography Focal Spot Measurement Test Stand** test stand is designed to make these important procedures easy to perform, and ensures accurate results. The test stand includes a magnification insert, alignment device, and fluorescent alignment screen.

**Designed by Joel E. Gray, Ph.D., Professor Emeritus, Department of Radiology, Mayo Clinic, Rochester, MN 55905. Manufactured under licensing agreement with Mayo Foundation for Medical Education and Research.

### 07-533 Radiopaque Rulers

All versions of the radiopaque rulers provide an anatomic landmark measurement scale on the radiographic image. Other applications where object firm distance (magnification) corrected measurement is needed.

07-623

07-533

*Designed by Joel E. Gray, Ph.D., Professor Emeritus, Department of Radiology, Mayo Clinic®, Rochester, MN 55905. Manufactured under licensing agreement with Mayo Foundation for Medical Education and Research.

## Specifications

**07-622**

| | |
|---|---|
| **Dimensions** | 12 in x 12 in at base; 6.15 in x 6.15 inch at top |
| **Height** | Adjustable from 16.94 in to 31.38 in |
| **Weight** | 5 kg (11 lb) |

**07-623**

| | |
|---|---|
| **Dimensions** | 9 in x 11.50 in at base; 4 in x 6 in at top |
| **Height** | Adjustable from 9 in to 18 in |
| **Weight** | 5 kg (11 lb) |

**07-533**

| Model | 07-533 | 07-533-1000 | 07-533-1100 | 07-533-3600 |
|---|---|---|---|---|
| **Dimensions** | 30 cm long, 2 mm divisions | 100 cm long, 2 mm divisions | 110 cm long, 2 mm divisions | 36 cm long, 2 mm divisions |
| **Weight** | 0.04 kg (0.05 lb) | 0.24 kg (0.5 lb) | 0.24 kg (0.5 lb) | 0.04 kg (0.05 lb) |

### Optional accessories

**07-622**

**89-622** Carrying Case
**07-633** Pinhole Assembly, 0.010 mm
**07-617** Pinhole Assembly, 0.075 mm
**07-613** Pinhole Assembly, 0.030 mm
**07-611** Pinhole Assembly, 0.100 mm

**07-623**

**89-622** Carrying Case
**07-611** Pinhole Assembly, 0.100 mm

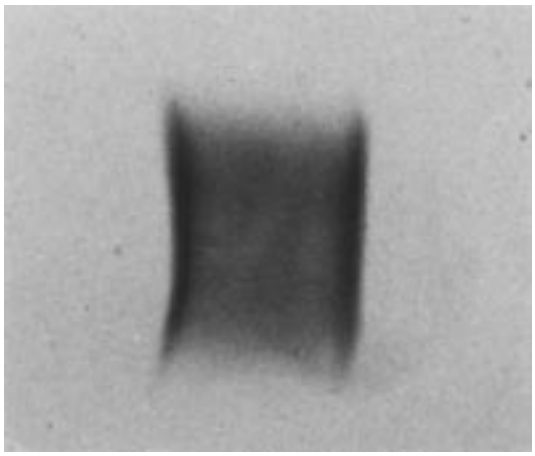
### Ordering information

**07-622** Multipurpose Focal Spot/HVL Test Stand
**07-623** Mammography Focal Spot Test Stand
**07-533** Radiopaque Ruler
**07-533-1000** Radiopaque Ruler
**07-533-1100** Radiopaque Ruler
**07-533-3600** Radiopaque Ruler

# 07-611 to 07-633, 07-620, and 07-635

## X-Ray Pinhole Assemblies and High-Quality Comparators

FLUKE® Biomedical



### 07-611 to 07-633 X-Ray Pinhole Assemblies

One of the specifications and chief features of an x-ray tube is its focal spot size, a very important factor in the resolution to be achieved during a radiologic examination. A small focal spot size will provide the maximum resolution. However, there are other factors in the construction of an x-ray tube, such as the heat dissipation within the target, which limits the minimum size of the target. In order to determine the focal spot size of an x-ray tube, a small and precise pinhole is often used. Its size must be very small compared to the focal spot to be measured. Any of four precision pinholes can be used with our 07-623 and 07-622 test stands. The test stand height is adjustable in order to maintain the minimum magnification factor of two. A fluoroscopic screen is part of the test stand and is used for centering the focal spot before exposing the film.

The 0.010 mm pinhole diameter is for focal spot sizes from 0.5 mm to 0.10 mm; the 0.030 mm pinhole diameter is for focal spot sizes below 1.0 mm; the 0.075 mm diameter is for focal spots from 1.0 mm to 2.5 mm; the 0.1000 mm diameter is for sizes above 2.5 mm.

The pinhole diaphragm is made from a 90:10 gold-platinum alloy in accordance with the table and figure.

### 07-620 and 07-635 High-Quality Comparators

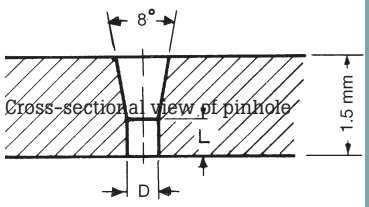
**Magnification 25X:** Supplied with a 0 to 5 mm reticle. Features a knurled ring that adjusts the focal point to personal preference. Transparent body allows illumination to fall on magnified area. Supplied with protective storage case. An excellent, high-quality precision magnifier.

**Magnification 7X**: Supplied with its own leather case. Fits in the palm of your hand. Transparent body allows illumination to fall on magnified area. Accurate, easy-to-use, versatile, and truly portable.

07-635

07-620

07-611 Pinhole assemblies




## Specifications

| Model | Pinhole diaphragm dimensions (mm) | | Nominal pinhole diameter (mm) |
|---|---|---|---|
| | D | L | |
| **07-633** | 0.010 ± 0.005 | 0.020 ± 0.010 | 0.010 |
| **07-613** | 0.030 ± 0.005 | 0.075 ± 0.010 | 0.030 |
| **07-617** | 0.075 ± 0.005 | 0.350 ± 0.010 | 0.075 |
| **07-611** | 0.100 ± 0.005 | 0.500 ± 0.010 | 0.100 |

Custom pinholes available on request.

| **07-620** | |
|---|---|
| **Weight** | 0.04 kg (0.05 lb) |
| **07-635** | |
| **Weight** | 0.10 kg (0.20 lb) |

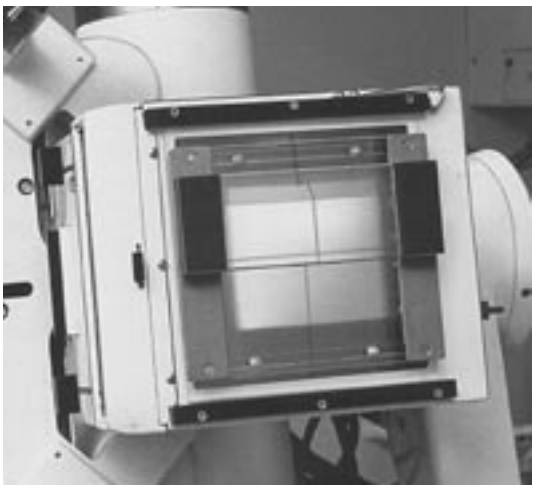
## Ordering information

**07-633** X-Ray Pinhole Assembly
**07-613** X-Ray Pinhole Assembly
**07-617** X-Ray Pinhole Assembly
**07-611** X-Ray Pinhole Assembly
**07-620** Comparator, 7X Magnification
**07-635** Comparator, 25X Magnification

# 57-4 Series

## CLEAR-Pb® Compensation Filters

FLUKE® Biomedical



Lightweight CLEAR-Pb lead-plastic filter is fully transparent

CLEAR-Pb Compensation Filters eliminate the problems inherent in imaging a wide range of densities on one radiograph. Because they are far superior, they replace the bulky, heavy aluminum filters that block the collimator light field. In addition, CLEAR-Pb filters are only one-fifth as heavy as aluminum filters. And, they eliminate the use of gradient-speed intensifying screens.

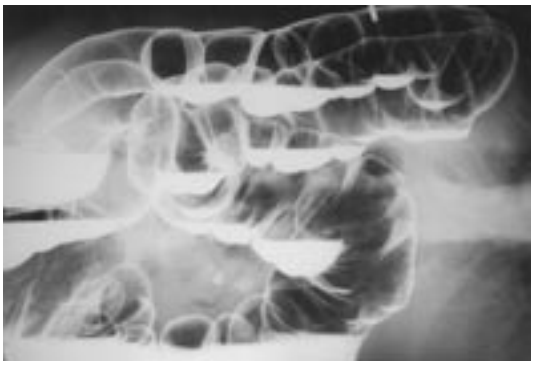
CLEAR-Pb filters are made of lightweight plastic that is 30 % lead by weight. A unique "quick-stik" magnetic mounting system plus a filter holder that slides into the collimator tray ensure that the filter is held firmly in place. It also permits instant repositioning as the area and/or degree of filter coverage changes.

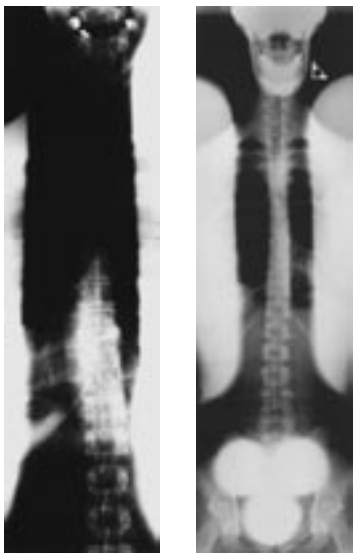
**Full-Spine Scoliosis Filter**
Tested and proven in FDA and specialized radiography studies, enables scoliosis radiography with more diagnostic detail and less radiation exposure.

### Key features

- Improve image quality
- Filters are 30 % lead by weight
- Reduce the need for multiple exposures
- Ensure a more uniform image density
- Reduce patient exposure by selectively attenuating the x-ray beam
- Lightweight, easy to use
- Mounts to any collimator
- Collimator light field is never blocked

Single-exposure AP view of the foot: radiograph at left wastaken without a CLEAR-Pb filter. Notice "burnout" at the toesdue to increased technique needed to properly expose the dense tarsal bones. The radiograph on the right was taken with a CLEAR-Pb filter. The image density is uniform from instep to toes.





Single-exposure spinal radiographs: the radiograph at left was obtained without a CLEAR-Pb filter. Notice "burnout" in cervical and thoracic areas. At right is radiograph obtained with a CLEAR-Pb AP/PA filter. Note uniform density throughout the spinal column.

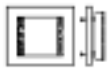
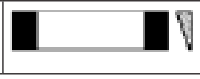
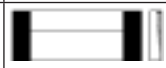
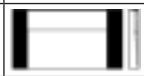
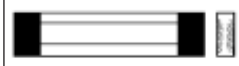
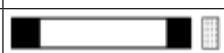
# 57-4 Series

## CLEAR-Pb® Compensation Filters

FLUKE® Biomedical

## Specifications

**CLEAR-PB Compensation Filters**

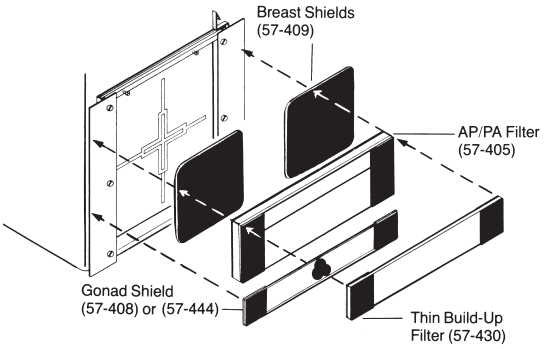
| Model | Filter | Weight | Length | Width | Filter holder required | Application | Configuration |
|---|---|---|---|---|---|---|---|
| **57-429** | Chest | 16 oz | 5.125 in | 5.125 in | No | PA View (72 in FFD) | |
| **57-432** | 2 inch Wedge Lateral Decubitus at 40 in FFD | 3.4 oz | 6.5 in | 2 in | Yes (see 57-426) | • All lateral decubitus position views<br>• Angiography of neck and head (use 2 filters) | |
| **57-433** | 3 inch Wedge Lateral Decubitus at 40 in FFD | 5.5 oz | 6.5 in | 3 in | Yes (see 57-426) | Suggested for children | |
| **57-426 (Required for 57-432, 57-433, 57-441)** | Filter Holder (set of mounting plates included) | 24 oz | 6.5 in | 6.5 in | Has two steel rails, (WxD) 1 in x 5.5 in, for positioning filters and shields. Only one F lter Holder is needed per x-ray machine. Comes with a Plexiglas cutter | |  |
| **57-440** | Foot and Ankle Filter | 3.9 oz | 6.5 in | 2 in | No | • AP foot<br>• Podiatric equipment | |
| **57-441** | 2 in Wedge AP Foot at 40 in FFD | 2 oz | 6.5 in | 2 in | Yes (see 57-426) | • Lateral and oblique<br>• Axial view of calcaneus |  |
| **57-414** | Wall Rack | 8 oz | 12 in | 1 in | Can hold a complete filter set plus 3 to 5 extra filters. Two-sided foam tape holds the rack to the wall. | | |
| **57-411** | Replacement Mounting Plate | 6.5 oz | 9 in | 9 in | Attaches to filter holder with screws. Easily cut to fit collimator assembly. Set of two. | | |
| **57-405*** | AP/PA (72 in FFD) | 5 oz | 6.5 in | 2.5 in | Yes (see 57-426) | Lateral chest |  |
| **57-415** | AP/PA (40 in FFD) | 9 oz | 6.5 in | 4.125 in | Yes (see 57-426) | Sectional, AP cervical thoracic |  |
| **57-406*** | Lateral Cervical (72 in FFD) | 3.2 oz | 6.5 in | 1.25 in | Yes (see 57-426) | • Lateral full spine (with 57-407 filter)<br>• Lateral aortic arch | |
| **57-407*** | Lateral Thoracic (72 inch FFD) | 2.6 oz | 6.5 in | 1.25 in | Yes (see 57-426) | • Oblique or AP esophagram (obese patients)<br>• Lateral chest tomography<br>• Routine lateral thoracic |  |
| **57-430** | Thin Buildup | 2.5 oz | 6.5 in | 2.5 in | Yes (see 57-426) | | |
| **57-434** | Thick Buildup | 3.5 oz | 6.5 in | 1.25 in | Yes (see 57-426) | |  |
| **57-437**** | Thin Wedge; for conventional machines | 8 oz | 6.5 in | 4.5 in | Yes (see 57-426) | AP scanograms, for determination of long-leg length discrepancies | |
| **57-438**** | Thick Wedge; for conventional machines | 13 oz | 6.5 in | 4.5 in | Yes (see 57-426) | • Full-leg radiography (under bodyweight load)<br>• Orthopedic angiographic<br>• Cross table lateral hips | |
| **57-408** | Adult Gonad Shield | 0.5 oz | 6.5 in | 1 in | Yes (see 57-426) | | |
| **57-444** | Pediatric Gonad Shield (72 inch FFD) | 0.25 oz | 6.5 in | 1 in | Yes (see 57-426) | | |
| **57 -402** | Basic Full-Spine Filter Set. Includes CLEAR-Pb AP/PA Filter (57-405), CLEAR-Pb Lateral Cervical Filter (57-406), Lateral Thoracic Filter (57-407), Adult Gonad Shield (57-408), Breast Shield Set (57-409), and Filter Holder (57-426). Weight: 1.4 kg (3 lb) | | | | | | |
| **57-445** | Deluxe Full-Spine Filter Set. Includes CLEAR-Pb AP/PA Filter (57-405), CLEAR-Pb Lateral Cervical Filter (57-406), Lateral Thoracic Filter (57-407), Thin Buildup Filter (57-430), Thick Buildup Filter (57-434), Adult Gonad Shield (57-408), Pediatric Gonad Shield (57-444), Breast Shield Set (57-409), and Filter Holder (57-426). Weight: 1.4 kg (3 lb) | | | | | | |
| **57-404** | X-Ray Protection System. Includes Adult Gonad Shield (57-408), Breast Shield Set (57-409), Filter Holder (57-426), and Pediatric Gonad Shield (57-444). | | | | | | |

*These models manufactured under licensing agreement with the Mayo Clinic® Mayo Foundation.
**These models manufactured under licensing agreement with Alvarado Orthopedic Research Company.

Lead-Steel Sandwich
Magnetic Tape
Plastic
Lead-Plastic

# 57-4 Series

## CLEAR-Pb® Compensation Filters




Thick Buildup Filter (57-434): same as 57-430 filter (above), but for patients whose measurements exceed 25 cm.

### Chest X-Ray Compensation Filter

For greater diagnostic detail over entire lung with fewer repeats. Reveals details that conventional x-rays usually miss.

The CLEAR-Pb Chest X-Ray Filter eliminates a problem commonly encountered in chest x-rays: a portion of the lung field is usually severely under-exposed because it is hidden behind the hilum. With the CLEAR-Pb filter, you can increase the beam intensity sufficiently so that all details of the lung and the posterior mediastinal field are clearly revealed. The CLEAR-Pb filter attenuates the x-ray beam while protecting the rest of the field from overexposure. You get clear diagnostic detail of the lungs, heart and spine.

### Lateral Decubitus X-Ray Compensation Filter

Excellent diagnostic detail in double-contrast barium enema examinations. To obtain the optimum diagnostic detail, the AP/PA Wedge Filter (57-405) should be used when performing fullspine examinations. First the Breast Shields (57-409) are placed on the filter holder. The AP/PA Wedge Filter (57-405) is placed on top of the Breast Shields. The Gonad Shield (57-408) is placed below the AP/PA Wedge Filter. Buildup filters are used to provide additional filtration in the cervical area to compensate for the added exposure that may be needed in the lumbar area. Buildup filters are placed on the AP/PA Wedge Filter.

### Reference


1. Gray J.E., Hoffman, A.D., Peterson H.A., Mayo Clinic: "Dose Reduction in Radiography for Scoliosis." J. Bone Joint Surg., (January, 1983), 5-12.
2. "Patient Exposure Reduction During Scoliosis Radiography," FDA Publication: 85-8251, August, 1985. Request Reprint No. 361B.
3. American Academy of Orthopedic Surgeons Bulletin 32:1, January, 1984.
4. Downey, E.F., Jr., Butler, P. "Less Radiation and Better Images: a New Scoliosis Radiography System," Milit. Med., 149 (September, 1984), 526-528.
5. Butler, P.F., Thomas, A.W., Thompson, W.E., Wollerton, M.A., Rachlin, J.A., "Simple Methods to Reduce Patient Exposure During Scoliosis Radiography." Radiologic Technology, 57:5 (1986).
6. Petersen, T.D., Rohr, W. "Improved Assessment of Lower Extremity Alignment Utilizing New Radiographic Techniques," Clinical Orthopedics, (June, 1987).
7. Feczko PJ, et al. "Compensation Filtration for Decubitus Radiography During Double-Contrast Barium Enema Examinations," Radiology, 149:3 (December, 1983), 848-850.


### Optional accessories

**Lead-Plastic Filters**

**57-409** Breast Shields provides protection to the radiosensitive breast and lung parenchyma adjacent to the spine. Fully adjustable; may be used on the Filter Holder Assembly (57-426) with or without a compensation filter. Consists of two 3 in x 3 in steel/lead shields with magnetic tape on one side.

**57-408** Adult Gonad Shield Shamrock-shaped insert has three overlapping lead circles (each 0.50 inch Ø) cemented to clear plastic.

**57-444** Pediatric Gonad Shield For imaging children and the sacroiliac joints of adults. Overlapping lead circles are 0.25 inch Ø.

**57-430** Thin Buildup Filter Used with AP/PA filters for patients with measurements from 14 cm to 25 cm. Provides additional filtration in the cervical area to compensate for the added exposure that may be needed in the thoracic/lumbar area.

### Included accessories

**57-402**
**57-405** AP/PA Filter
**57-406** Lateral Cervical Filter
**57-407** Lateral Thoracic Filter
**57-408** Adult Gonad Shield
**57-409** Breast Shield Set
**57-426** Filter Holder

**57-445**
**57-405** AP/PA Filter
**57-406** Lateral Cervical Filter
**57-407** Lateral Thoracic Filter
**57-430** Thin Buildup Filter
**57-434** Thick Buildup Filter
**57-408** Adult Gonad Shield
**57-444** Pediatric Gonad Shield
**57-409** Breast Shield Set
**57-426** Filter Holder

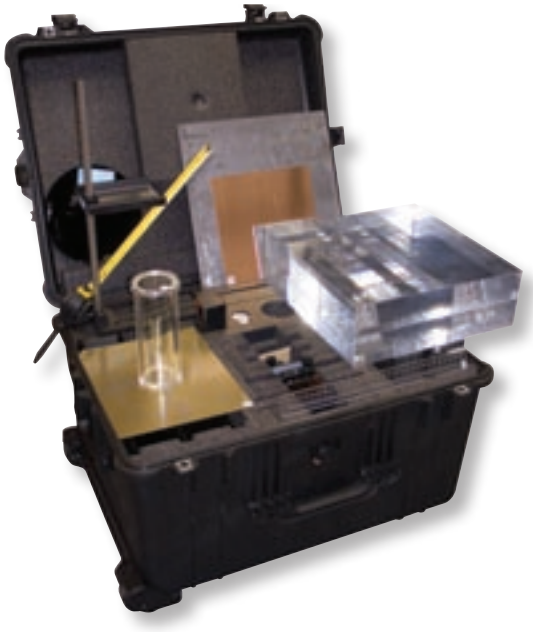
**57-404**
**57-408** Adult Gonad Shield
**57-409** Breast Shield Set
**57-426** Filter Holder
**57-444** Pediatric Gonad Shield

### Ordering information

**57-429** Chest Filter
**57-432** 2-inch Wedge Lateral Decubitus at 40-inch FFD
**57-433** 3-inch Wedge Lateral Decubitus at 40-inch FFD
**57-426** Filter Holder (set of mounting plates included)
**57-440** Foot and Ankle Filter
**57-441** 2-inch Wedge AP Foot at 40-inch FFD
**57-414** Wall Rack
**57-411** Replacement Mounting Plate
**57-405** AP/PA (72-inch FFD)
**57-415** AP/PA (40-inch FFD)
**57-406** Lateral Cervical (72-inch FFD)
**57-407** Lateral Thoracic (72-inch FFD)
**57-430** Thin Buildup
**57-434** Thick Buildup
**57-437** Thin Wedge for conventional machines
**57-438** Thick Wedge for conventional machines
**57-408** Adult Gonad Shield
**57-444** Pediatric Gonan Shield (72-inch FFD)
**57-402** Basic Full-Spine Filter Set
**57-445** Deluxe Full-Spine Filter Set
**57-404** X-Ray Protection System

# 07-600QC/07-600QCN

## Quality Control Kit



Fluke Biomedical's 07-600QC Quality Control Kit is ideal for performing quality-assurance inspections in conventional radiography applications. The 07-600QC is best used in conjunction with a dosimeter kit, enabling the user to measure and verify the quality of x-ray tube voltage accuracy, linearity, and reproducibility of the x-ray beam, as well as the dose rate. Originally designed to meet French regulations. The kit is ideal for use anywhere comprehensive quality assurance is needed.

**The 07-600QC Quality Control Kit comes in two configurations:**

The 07-600QC is the standard quality-control kit and includes all of the recommended phantoms and test objects for quality control to meet regulatory requirements. This kit is best paired with Fluke Biomedical's 10500AMT TRIAD™ TnT x-ray test device, allowing users to accurately test the integrity of their x-ray tube.

The 07-600QCN is also designed to work with Fluke Biomedical's 8000 NERO® mAx x-ray test device. This kit version includes all the components of the 07-600QC, as well as several additional accessories to improve the setup and ease-of-use while testing with the 8000 NERO mAx.

Both kits come in a rugged carrying case, designed to easily transport and protect all of the phantoms and test object. The carrying case also doubles as a safe storage compartment, conveniently holding all of the delicate components.

### Key features

- Includes all of the phantoms and test objects needed for quality control in conventional radiography applications
- Ideal for QC measurements of beam geometry, kilovoltage, and radiation quality, spatial resolution, automatic exposure control (AEC) function, and half-value layer (HVL) to meet regulatory requirements
- Custom carrying and storage case with sturdy wheels and extendable pull handle allows users to easily transport components from site to site

### Included accessories

**07-600QC**

Al plate (1 $mm^2$ x 100 $mm^2$)
Two Al plates (2 $mm^2$ x 100 $mm^2$)
Two Cu plates (1 $mm^2$ x 200 $mm^2$)
Pb assembly (2 $mm^2$ x 300 $mm^2$ between two pieces of 2 mm PMMA)
Four PMMA plates (50 $mm^2$ x 300 $mm^2$ with four polyethylene spacers)
Leeds TOR 18FG phantom
Leeds TOR Cu plate
**07-661-7662** Three-piece Collimator Alignment Tool
**07-533** Radiopaque Ruler
**07-523-2000** Test Pattern
**07-620** Magnifier
Metric Tape Measure (3 m)

**07-600QCN**

All components from the 07-600QC kit plus
**37596** 8000 NERO mAx stand base
**37589** Stand Vertical Rod
**37586** HVL Holder
One stand for external ion chamber

### Ordering information

**07-600QC** Quality Control Kit
**07-600QCN** Quality Control Kit for Fluke Biomedical 8000 NERO mAx system

FLUKE®
Biomedical

# 07-680

## NEMA® Cardiology Phantom

Figure 1. The NEMA Cardiology phantom

The 07-680 NEMA Cardiology Phantom was designed by collaboration with SCA&I to provide a cardiovascular fluoroscopy benchmark phantom. It is used to test systems under conditions simulating normal clinical use for fluoroscopically-guided invasive and interventional procedures.

The phantom test ensemble includes: tests for imaging-field geometry, spatial resolution, low-contrast iodine detectability, working thickness range, motion unsharpness and phantom entrance dose.

### Key features

- Independent confirmation: Reassurance of an optimally working system
- Quick evaluation: The machine is tested in its clinical configuration
- Verification: That the system actually needs to be serviced, allowing you to save time, money and avoid more serious problems later on
- Ease-of-use: Anyone with technical knowledge can do the tests to determine if corrective action is necessary
- Peace of mind: To make sure that you are getting just what you paid for

### Applications

Test objects are positioned at the center of the NEMA Cardiology Phantom. This simulates the location of clinically important organs. The NEMA Cardiology Phantom, positioned with its center at the x-ray system's isocenter, simulates clinical imaging geometry. Therefore, the geometric magnification of the test objects is similar to that of the clinical target. The receptor blur, focal spot penumbra blur and x-ray scatter are also similar in test and clinical conditions. The entrance surface of a thick phantom is closer to the x-ray tube than the entrance surface of a thin phantom. This is an additional reason why patient (phantom) dose increases with phantom thickness.

- Visualized field size: A plate is placed on the entrance surface of the image receptor. The plate is fluorographed to determine the actual field of view (FOV).
- Congruence of irradiated and visualized fields: This test is not needed if the shutters are fully seen in the FOV under test. (CAUTION: digitally synthesized shutters may simulate this effect without actual beam collimation.)
- Spatial resolution: A standard bar pattern insert is included in the central test plate. The test plate is placed with the bars at 45° to the video lines or digital image matrix. This produces the smallest change in the moiré pattern, resulting from a small change in angle. See Figures 2 and 3.

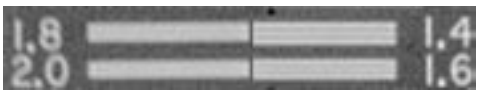



Figure 2. Spatial Resolution: the 1.4 and 1.6 line-pair/mm targets are resolved. The 1.8 and 2 targets are not resolved.

# 07-680

## NEMA® Cardiology Phantom

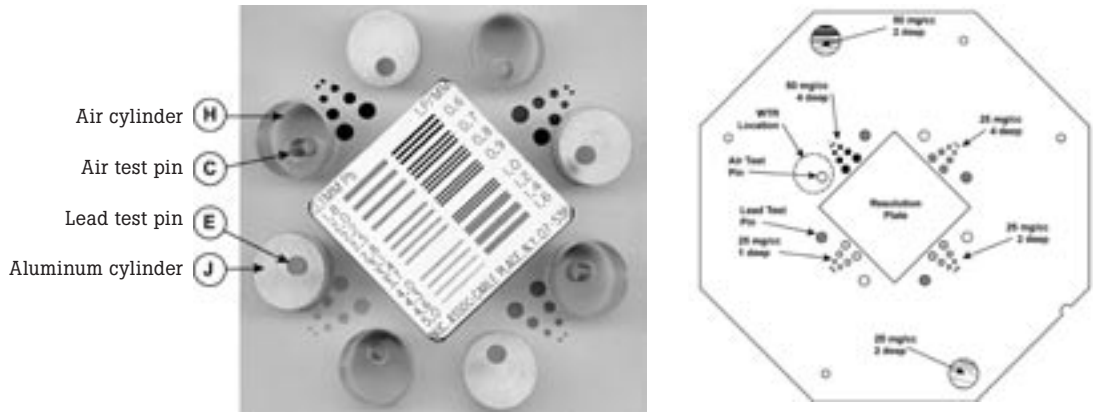



Figure 3. Photograph and diagram of the central test plate. Note the resolution test plate, iodine contrast-detail targets, and working thickness range targets.

- Low-contrast detectability: Four sets of holes with diameters of 4 mm, 3 mm, 2 mm, and 1 mm are filled with elemental iodine dispersed in epoxy. The relative areal concentration of iodine in the four patterns is 20, 10, 5, 2.5 mg/cm$^2$. The test operator is required to identify the smallest visible pair of targets in each pattern. See Figure 4.
- Visibility of moving structures: A rotating spoke target allows visual evaluation of motion unsharpness and the effects of temporal averaging. The device contains five steel wires of different diameters (0.022 in, 0.016 in, 0.012 in, 0.009 in and 0.005 in or 0.56 mm, 0.41 mm, 0.30 mm, 0.23 mm, 0.13 mm). Two lead dots are used to evaluate lag and recursive filtering. Rotation speed is 30 revolutions/min. The linear velocity of the outer lead dot is 200 mm/sec. The rotating disk replaces the central test plate at the isocenter. See Figure 5.
- Dosimetry tools: The NEMA Cardiology Phantom entrance exposure rate is measured at a standardized position in front of the entrance surface of the phantom (25 mm). This position is considered an acceptable choice for this particular benchmarking phantom. The phantom can also be configured to generate the FDA measuring point (30 cm in front of the image receptor). See Figure 6.
- Working thickness range: The ability to image structures overlaid by bone or air. Systems with inadequate single-image latitude are unable to do this in bright (air) or dark (bone) portions of the image. The NEMA Cardiology Phantom contains eight cylinders composed of different heights of air, aluminum and plastic. These cylinders are calibrated for a total 20 cm phantom thickness. A 50 mm deep air challenge target overlaps the four air cylinders. The bright side dynamic range is determined by how many of these targets are seen. A 5 mm lead challenge target overlaps the four aluminum cylinders. The dark side dynamic range is determined by counting these targets. See Figure 4.

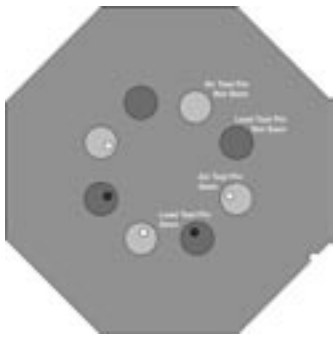


Figure 4. Working thickness range. Three examples of white clipping and two examples of black clipping

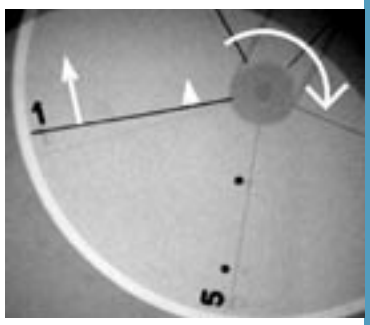



Figure 5. Motion target

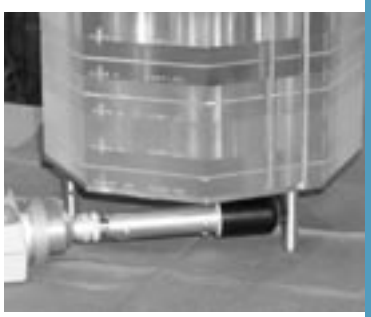


Figure 6. Example of typical dosimetry measurement Geometry. Dosimetry center is always 25 mm below bottom of phantom

# 07-680

## NEMA® Cardiology Phantom

### How does the NEMA Cardiology Phantom actually work?

The field size plate is placed on top of the phantom. A second plate with a centered radiopaque dot is placed in the base. The imaging gantry is adjusted until the cross wires intersect the approximate center of the disk. See Figure 7.

Fluorographs A and B demonstrate acceptable alignment of the NEMA phantom.

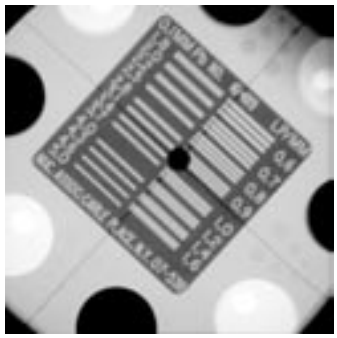
In fluorograph A, the spatial resolution test plate and several of the low contrast detectability targets are shown. Both lines cross at the dot.

Fluorograph B shows both lines crossing at the dot. (The test plates have been removed.)

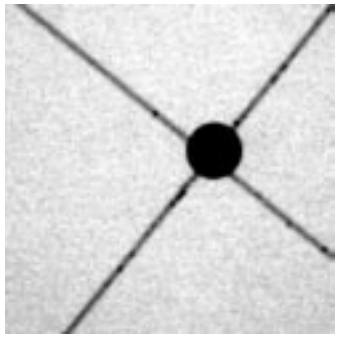
Fluorographs C and D demonstrate poor alignment of the NEMA phantom.

In fluorograph C, the spatial resolution test plate and several of the low contrast detectability targets are also seen in this image. The intersection of the two lines is outside the dot.

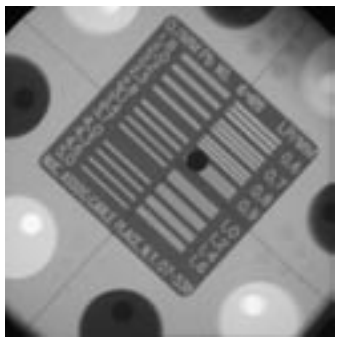
Fluorograph D shows the intersection of the two lines outside the dot. (The test plates have been removed.)



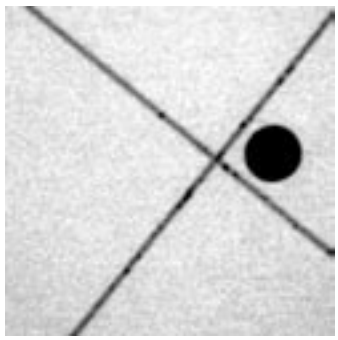
A



B

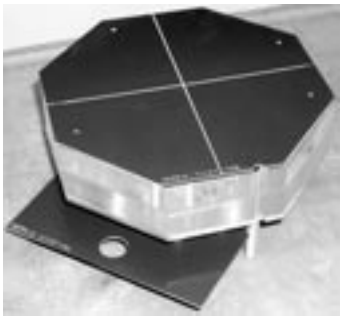


C

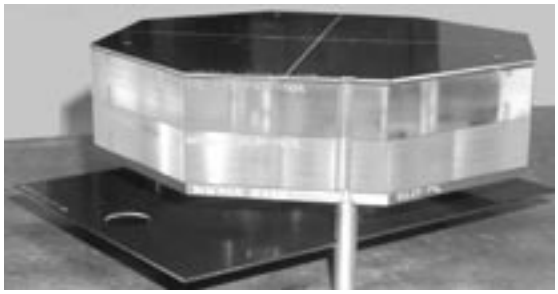


D

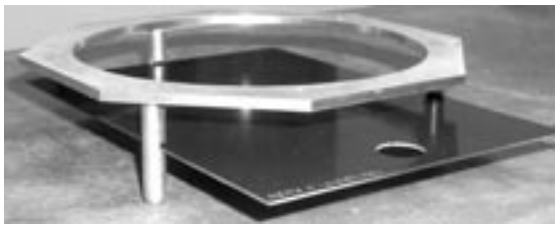
Figure 7. Alignment Tools



*NEMA Base with both lower (dot) and upper (cross) alignment plates in position



*NEMA Base with both lower (dot) and upper (cross) alignment plates in position. Note that the grooves on the side of each plate ensure the correct orientation of the plates

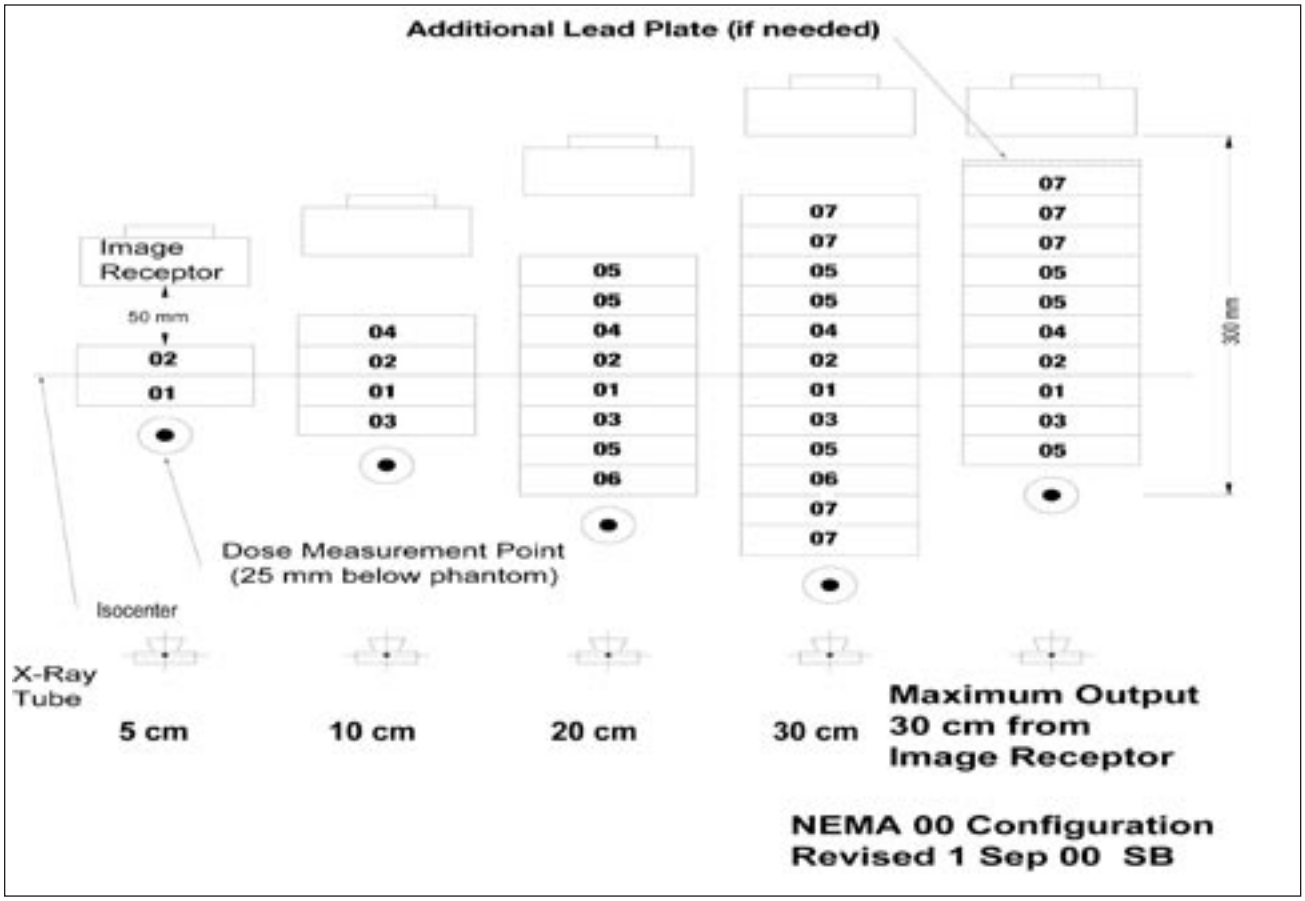


NEMA Base with lower alignment plate (dot plate) in position. Note that the leading edge of the plate fully engages the cutout in the rear leg

# 07-680

## NEMA® Cardiology Phantom

**Plate identification and stacking order**




## Specifications

| Material | Thickness tolerance | Comments |
|---|---|---|
| **PMMA plates** | ± 1 mm | |
| **Aluminum** | ± 0.5 mm | Type-1100 |
| **Piano wires** | Commercial steel | These are "standard" items |
| **Lead pins** | ± 1 mm | |
| **Lead plate** | ± 0.1 mm | |
| **Copper plate** | ± 0.1 mm | |
| **Iodine** | ± 5 % | Reagent grade tolerance is concentration in epoxy |
| **PC boards** | | Solder-covered traces thick enough to be seen through 30 cm of PMMA |

### Included accessories

Phantom, rotating target (110 V or 220 V), test stand, alignment pins, x-ray test pattern, and carrying case

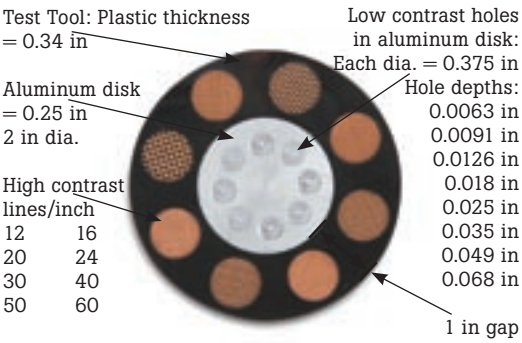
### Ordering information

**07-680** NEMA Cardiology Phantom

# 07-649

## CDRH Fluoroscopic Phantom

FLUKE® Biomedical



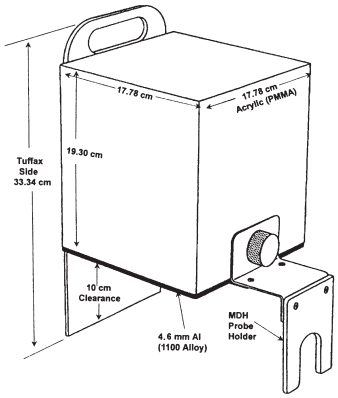

The Nationwide Evaluation of X-Ray Trends (NEXT*) fluoroscopy protocol has been issued to provide guidelines for quality control procedures for diagnostic fluoroscopy. In order to perform these procedures, a suitable phantom was developed: the 07-649 CDRH Fluoroscopic Phantom.

In a survey of fluoroscopic facilities for the NEXT program, it was determined that a substantial proportion of facilities could not visualize low-contrast test objects; this strongly suggests image quality problems. Measurements for this survey were performed using the 07-649 CDRH Fluoroscopic Phantom. In addition to air kerma rate (free in air) measurements, imaging performance was assessed using the Fluoroscopic Image Quality Test Object (included with phantom). The phantom also contains a lead stop plate and copper attenuation plate.

By using the 07-649 CDRH Fluoroscopic Phantom, doses at fluoroscopy can be reduced, and fluoroscopic image quality can be improved.

### Key features

- Conforms to Center for Devices and Radiological Health (CDRH) specifications
- This phantom is now required in order to comply with QC tests recommended in the ACR's Barium Enema QC Manual
- Recommended in AAPM Report No. 60, "Instrumentation Requirements of Diagnostic Radiological Physicists"
- Optimized for both under- and over-table fluoroscopic tubes
- Compact, and easy to use




*The Conference of Radiation Control Program Directors (CRCPD), the professional organization of state and local radiation control agencies, along with the Food and Drug Administration (FDA) of the federal government, conducts the Nationwide Evaluation of X-Ray Trends (NEXT) survey program.

## Specifications

| This patient-equivalent phantom of uniform thickness consists of a 7 inch thick acrylic block, one Fluoroscopic Image Quality Test Object, one lead stop plate and one copper attenuation plate. | |
|---|---|
| **Base** | (2) type-1100 aluminum plates, each 2.3 mm thick |
| **Phantom** | (4) lead beads embedded on top, to be used as collimation orientation points |
| **Lead stop plate** | This 3.2 mm (0.125 in) plate simulates maximum attenuation, and can be used to measure the maximum air kerma rate (free in air) |
| **Copper attenuation plate** | This 1.6 mm (0.06 in) copper filter simulates the presence of a 2 mm thick layer of barium sulfate, and can be used to measure the air kerma rate (free in air). |
| **Fluoroscopic image quality test object** | This is comprised of eight low-contrast test holes (each 0.375 in Ø, and ranging in depth from 0.0063 in to 0.068 in) and eight wire meshes (ranging from 12 to 60 lines per inch). The test object is used for the assessment of spatial resolution, and can easily be taken on and off the phantom. |
| **Dimensions** (LxWxH) | 17. 8 cm x 17.8 cm x 19.3 cm (7 in x 7 in x 8 in) |
| | It stands on two legs, approximately 4 inches off the tabletop. One leg is specially designed as a probe holder. |
| **Weight** | 9.55 kg (21 lb) |

### Optional accessories

**07-649-1169** Fluoroscopic Image Quality Test Object

### Included accessories

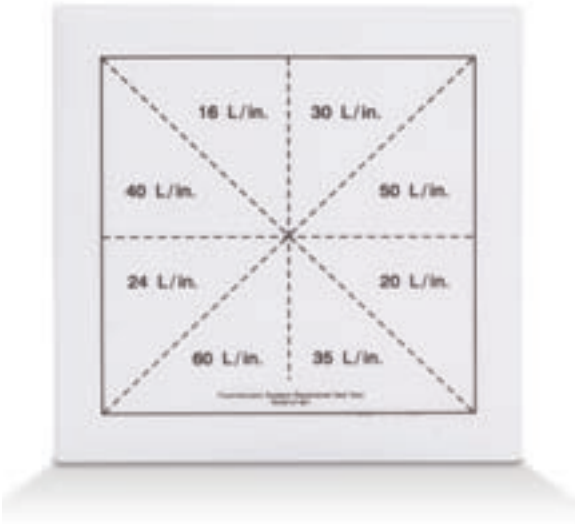
Fluoroscopic image quality test object, lead stop plate, and copper attenuation plate

### Ordering information

**07-649** CDRH Fluoroscopic Phantom

# 07-601 and 07-800 Series

## Fluoroscopic System Resolution Test Tools and Flex Film Cassettes




**07-601 Fluoroscopic System Resolution Test Tools**
The Fluke Biomedical Flouroscopic Resolution Tools are 7.5-inch square, plastic plates that each have a 7-inch square area containing eight groups of copper or brass mesh screening in the following mesh-size ranges: 16 to 60 lines/inch, 30 to 100 lines/inch or 60 to 150 lines/inch. The screens are arranged in an irregular rotation to permit discrete visualization of groups. They can also be used to optimize television system focus as well as mirror optics and image intensifier settings.

**07-800 Series Flex Film Cassettes**
The 07-800 Series Flex Film Cassettes are flexible vinyl x-ray film holders that provide unsurpassed detail and resolution. Unlike conventional cassettes, Flex Film Cassettes contain no screen, so you get direct exposure of the x-ray film and a better image. Flex Film Cassettes offer an ideal combination of firmness and flexibility for a variety of medical and industrial applications; that's why they are the most widely used flexible film cassettes in the industry.

Flex Film Cassettes are the best choice for QC testing of imaging equipment. They are ideal for use with such test tools as: the Mini CT QC Phantom, all X-Ray Test Patterns, and all Focal Spot Imaging Test Tools, as well as many others.

### Key features

**07-601**

- For resolution checks of fluoroscopic imaging systems

**07-800**

- Convenient to use: an alignment grid is printed on one side
- Easy-to-load: they fit easily around contoured items
- Durable: use them again and again
- Resistant to moisture and dirt: they're easy to clean
- Available in custom sizes: cassettes have been manufactured in sizes up to 68 inches long. Metric sizes are also available on special order

## Specifications

| 07-601 | |
|---|---|
| **Dimensions** (WxDxH) | 19 cm x 19 cm x 0.3 cm (7.5 in x 7.5 in x 0.35 in) |
| **Weight** | 0.225 kg (0.5 lb) |
| **07-800 Series** | |
| **Weight** | Less than 1 lb |

### Ordering information

**07-601** Fluoroscopic Resolution Tool, 16-60 mesh
**07-619** Fluoroscopic Resolution Tool, 30-100 mesh
**07-618** Fluoroscopic Resolution Tool, 60-150 mesh
**07-601-1414** Fluoroscopic Resolution Tool, 16-60 mesh, 14 in x 14 in
**07-800-5007** Flex Film Cassette, 5 in x 7 in
**07-800-8010** Flex Film Cassette, 8 in x 10 in
**07-800-8012** Flex Film Cassette, 8 in x 12 in
**07-800-1012** Flex Film Cassette, 10 in x 12 in
**07-800-1417** Flex Film Cassette, 14 in x 17 in

# 07-600 and 07-678+

## Fluoroscopic Beam Alignment Device and DXR Direct X-Ray Ruler

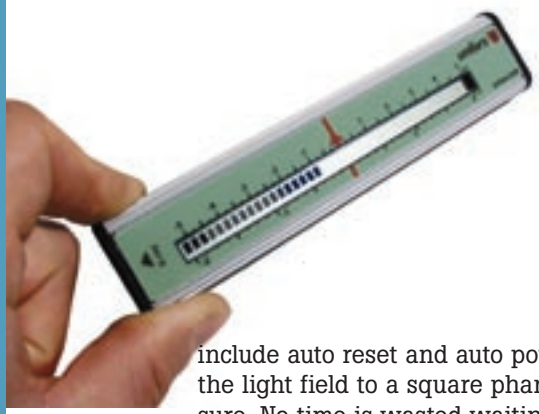
FLUKE® Biomedical

**07-600 Fluoroscopic Beam Alignment Device**

In misaligned fluoroscopic image intensifier systems, the portion of the field that falls outside the visible area of the image receptor does not contribute to the useful fluoroscopic image and can result in unnecessary exposure to the patient.

If corrective measures are required, the 07-600 Fluoroscopic Beam Alignment Device will provide a measurement of optimum beam alignment.

It consists of an aluminum plate with four sliding brass strips set in recessed channels. The strips define the visible area of the image receptor and are adjustable with respect to the center of the measurement plate. A transparent plastic overlay on the aluminum plate prevents the vertical displacement of the brass strips. Holes drilled at 0.5 inch intervals through the center of each channel are filled with high density plugs. The visibility of the plugs in the fluoroscopic image permits their use as a means of centering the device.



**07-678+ DXR Direct X-Ray Ruler**

The 07-678+ DXR, Direct X-Ray Ruler, represents the latest in today's technology for alignment of the light and radiation field.

The 07-678+ DXR is extremely easy to use as it is powered on by simply exposing the meter. Features include auto reset and auto power off. There is no need to adjust the light field to a square phantom before making an exposure. No time is wasted waiting for films to be developed. The pocket-sized DXR gives an objective, reproducible and immediate read-out.

### Key features

**07-600**

- Reduces exposure to the patient

**07-678+**

- Fully automatic
- 10 ms exposure time
- Auto power on
- Auto power off
- 6 years to 8 years battery life

## Specifications

| | |
|---|---|
| **07-600** | |
| **Dimensions** (WxDxH) | 23 cm x 23 cm x 1.6 cm (9 in x 9 in x 0.625 in) |
| **Weight** | 2.27 kg (5 lb) |
| **07-678+** | |
| **Range (Mammo)** | 30 kVp, 50 kVp, 70 kVp, 100 kVp |
| | >100 mA, >200 mA, >100 mA, >100 mA |
| **Dimensions** (WxDxH) | 15 mm x 30 mm x 145 mm (0.59 in x 1.18 in x 5.71 in) |
| **Weight** | 75 gr (2.6 oz) |

### Ordering information

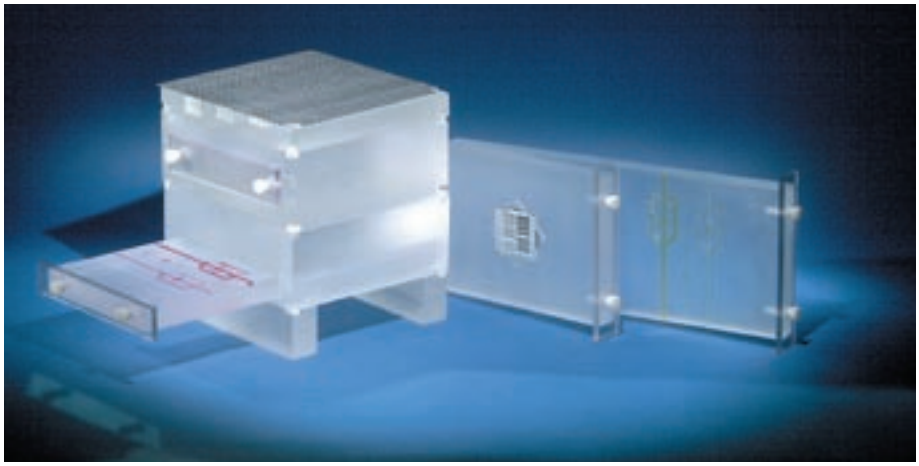
**07-600** Fluoroscopic Beam Alignment Device

**07-678+** Direct X-Ray Ruler

FLUKE®
Biomedical

# 76-710

## Digital Subtraction Angiography (DSA) Phantom*



This 76-710 Digital Subtraction Angiography (DSA) Phantom† conforms to the recommendation in Report No. 15 by the American Association of Physicists in Medicine (AAPM)—Digital Radiology/Fluorography Task Group of the Diagnostic X-Ray Imaging Committee.

Dramatic improvement in the quality of the subtracted image due to improved phantom stability and increased homogeneity of bone material in bone blocks.

This phantom eliminates occurrence of mis-registration artifacts caused by inadvertent movement of the phantom components during image acquisition

### Key features

- Conforms to Report #15 by the American Association of Physicists in Medicine (AAPM)
- Checks contrast range, resolution, linearity, uniformity, amplifier dynamic range, registration accuracy and subtraction effectiveness
- Provides easy-to-interpret results
- Quantitatively measures high- and low-contrast spatial resolution
- Retaining hasps ensure a tight fit between the step blocks, for reduced motion artifacts
- Specially-designed "stop" on the end of the slot blocks improves the positional accuracy of the insert material during image acquisition, and reduces the number of DSA frames that must be acquired
- The U-block provides a very sturdy support when entrance exposures are being measured with a dosimeter ion chamber
- Two artery blocks in two concentrations of iodine: 15 mg/ml and 150 mg/ml, for increased clinical relevance
- A 300 mg/ml iodine artery block is available as an option

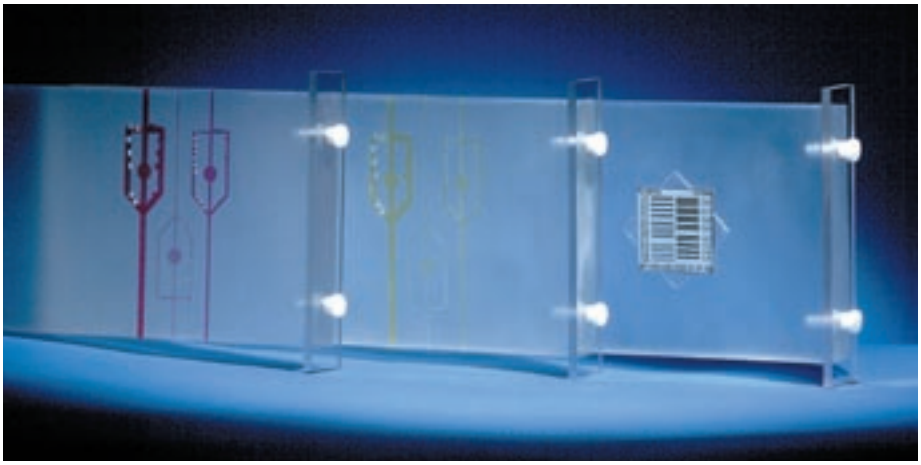
* Designed by Joel E. Gray, Ph.D., Professor Emeritus, Mayo Graduate School of Medicine and Jerome P. Taubel, R.T., Department of Diagnostic Radiology, Mayo Clinic® and Foundation. Manufactured under licensing agreement with Mayo Foundation for Medical Education and Research.

† This phantom conforms to the recommendation in Report #15 by the American Association of Physicists in Medicine (AAPM)-Digital Radiography/Fluoroscopy Task Group of the Diagnostic X-Ray Imaging Committee.

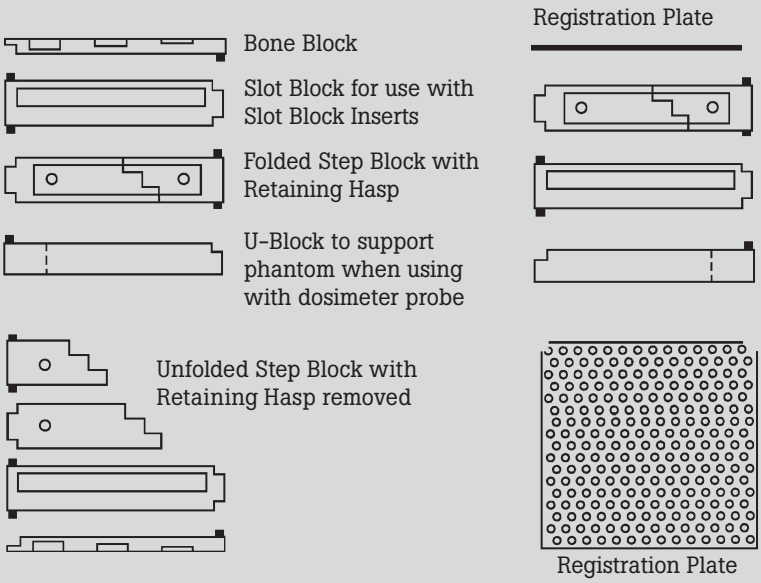
# 76-710

## Digital Subtraction Angiography (DSA) Phantom

FLUKE® Biomedical



### Possible DSA phantom configurations


Bone Block
Slot Block for use with Slot Block Inserts
Folded Step Block with Retaining Hasp
U-Block to support phantom when using with dosimeter probe
Unfolded Step Block with Retaining Hasp removed
Registration Plate
Registration Plate

### Optional accessories

**76-705** Artery Block, with 15 mg per ML venous concentration
**76-705-1150** Artery Block (from 76-700-1150 phantom), with 150 mg per ML arterial concentration
**76-705-1300** Artery Block (from 76-700-1300 phantom), with 300 mg per ML arterial concentration
**76-711** Step Wedge
**76-712** Slot Block
**76-713** Bone Block
**76-714** Blank Insert
**76-715** Low-Contrast Artery Insert
**76-716** Low-Contrast Iodine Line Pair Insert
**76-717** High-Contrast Resolution Pattern Insert, does not include test pattern(s)
**76-718** Registration Plate
**76-719** Linearity Insert

**Optional high-contrast resolution test patterns**

**07-527** High-Precision Test Pattern, 0.01 mm thick
**07-538-1000** High-Precision Test Pattern, 0.1 mm thick
**07-538-2000** Ultra-High Precision Test Pattern, 0.1 mm thick

## Specifications

| Physical | |
|---|---|
| **Weight** | 13.9 kg (30.7 lb) |

### Included accessories

Registration Plate, 150 mg/ml Artery Block, Bone Block, U-Block Base, Slot Block, 15 mg/ml Artery Block, Step Block, Retaining Hasps

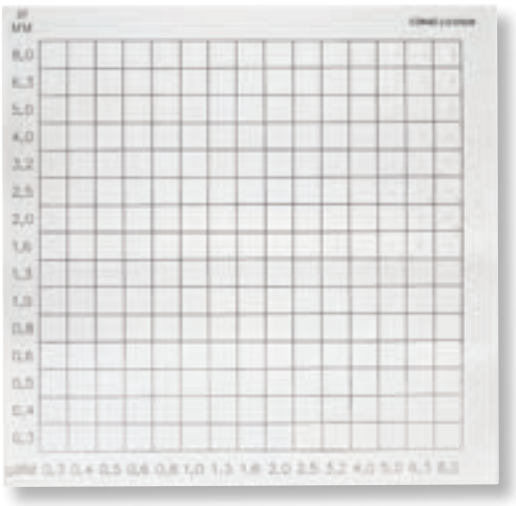
### Ordering information

**76-710** DSA Phantom

FLUKE®
Biomedical

# 07-652

## CDRAD Contrast Detail Digital and Conventional Radiography Phantom



Most definitions of image quality in radiology are based on characterizing the physical properties of the image chain. However, medical diagnosis is not made by the image alone; observer perception greatly affects the result.

**Digital radiography**

The 07-652 CDRAD Phantom is an excellent tool for evaluating the imaging characteristics of digital radiographic systems, including stimulable phosphor computed radiography systems and teleradiography systems.

One of the principle concerns with the use of digital radiography is the potential reduction in the visibility of detail due to the blurring introduced at various places within the system, such as the film digitizers, display monitors, and the sampling of the image into discrete pixels. Loss of detail is the image characteristic which can have an adverse affect on diagnosis. Resolution (bar phantom) test objects which are used to evaluate conventional x-ray imaging systems are generally not appropriate for evaluating digital systems. The 07-652 CDRAD Phantom provides a reliable and objective evaluation of the loss of detail from blurring at any point within the system.

### Key features

- Optimized for evaluation of digital systems
- Improves diagnostic accuracy
- Can also be used for conventional radiography systems

**Used to evaluate loss of detail in:**

- Film digitizers
- Computed Radiography (CR) systems
- Display monitors
- Laser printers

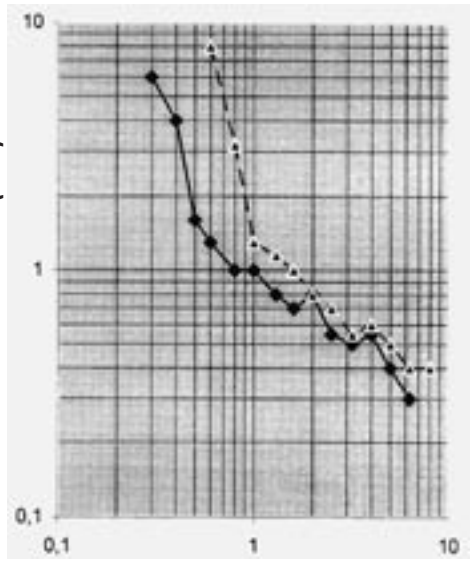
**Used to adjust and optimize:**

- Image processing parameters
- Viewing conditions

FLUKE®
Biomedical

# 07-652

## CDRAD Contrast Detail Digital and Conventional Radiography Phantom




Contrast detail lines of monitor image (◆) and the hard copy image (①) from the same digital equipment

**Image evaluation**

- To evaluate the phantom image, the observer indicates the location of the second spot in each square. Correct indication proves that a contrast is actually seen.
- At the transition from visible to invisible, it is difficult to decide in which corner the second spot is located, and the response equals pure chance.
- The line connecting the central spots with the smallest visible diameter and contrast is called the Contrast Detail (CD) curve.
- For comparison of the imaging performance of different systems, phantom images are made under identical conditions and evaluated by the same observer at the same time. The better system will produce an image in which smaller contrasts and details are visible. This results in a shift of the CD curve to the lower left part of the image. (See graph)
- In the detail (vertical) direction, the diameter of the holes increases step-wise and logarithmically from 0.3 mm to 8 mm. The image shows 15 rows of spots with increasing detail.

## Specifications

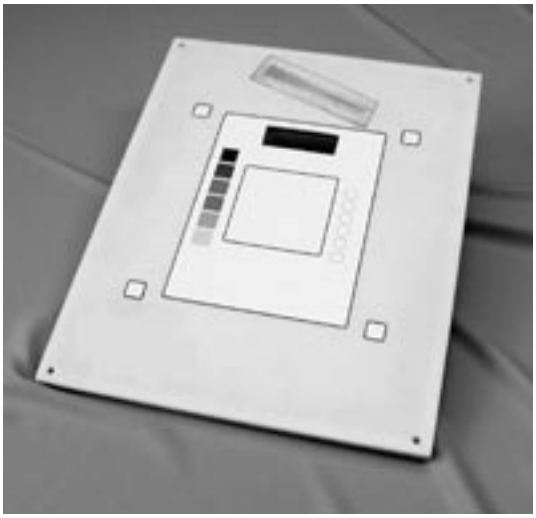
| | |
|---|---|
| **Plexiglas® tablet** | Cylindrical holes of exact diameter and depth (tolerances: 0.02 mm) |
| **Radiographic image** | Provides information about the imaging performance of the whole system |
| | 225 squares: 15 rows and 15 columns |
| | In each square, either one or two spots (the images of the holes) are present. The first three rows show only one spot, while the other rows have two identical spots; one in the middle and one in a randomly chosen corner. (See graph) |
| | The optical densities of the spots are higher than the uniform background |
| | In the contrast (horizontal) direction, the depth of the holes increases logarithmically, and the image shows 15 columns of spots with increasing contrast |
| **Performance comparison** | Comparison of the performance of several observers is also possible. The better performing observer produces a CD curve more to the lower left part of the image |
| **Dimensions** (WxDxH) | 26.4 cm x 26.4 cm x 0.76 cm (10.4 in x 10.4 in x 0.3 in thick) |
| **Weight** | 1.34 kg (3 lb) |

### Ordering information

**07-652** CDRAD Contrast Detail Digital and Conventional Radiography Phantom

# 07-605-7777

## CR/DR DIN Test Tool



The 07-605-7777 CR/DR DIN Test Tool is a timely and valuable solution to the image quality maintenance problem. Technologists, radiologists and physicists can easily perform quick and reliable assessments of their CR/DR systems.

Today's new image acquisition chains are considerably more complex than conventional screen/film systems. Computed Radiography (CR)/ Digital Radiography (DR) systems involve special processing for each body part. This is controlled by computers, rather than chemical processors and soft copy displays, which are calibrated using light meters rather than visual inspection. CR/DR systems also incorporate laser beams, photomultiplier tubes, network gateways and laser printers. The 07-605-7777 is designed specifically for evaluating the entire CR/DR image acquisition chain.

Ideal for use as a preventive maintenance quality control test tool, the 07-605-7777 can also be used to take regularly scheduled measured data points from the image, such as line pair resolution measurements, ROIs (regions of interest) and geometry symmetry. Measurements/angle can be used to evaluate monitor, as well as printed film image quality.

By performing daily quality-control checks, both before the first patient is examined and at the end of the day, equipment problems can be accurately and easily pinpointed and corrected. Equipment downtime is significantly reduced, resulting in increased patient throughput. Patients no longer need to endure repeat exams due to poor image quality.

You'll soon realize a dramatic savings in film costs when you use the 07-605-7777 as part of your QC program. In addition, radiological personnel will experience significantly less of the problems and frustrations associated with equipment maintenance and thank you for it.

### Key features

- Quick and easily optimize images from your CR/DR system
- Effectively reduces equipment downtime
- Incorporates the "DIN" standard test pattern, DIN 6868/58
- Dramatically reduces repeat patient exams; thus preventing unnecessary patient exposure due to problems related to the image acquisition chain and poor image quality
- Lightweight, durable
- Easy-to-use, no moving parts
- Cost-effective
- Quickly verifies important parameters, including dynamic range, contrast resolution, homogeneity, and resolution

## Specifications

| | |
|---|---|
| **Dimensions** (WxDxH) | 35.5 cm x 43.1 cm x 1.5 cm (14 in x 17 in x 0.5 in) |
| **Weight** | 3.2 kg (7.05 lb) |

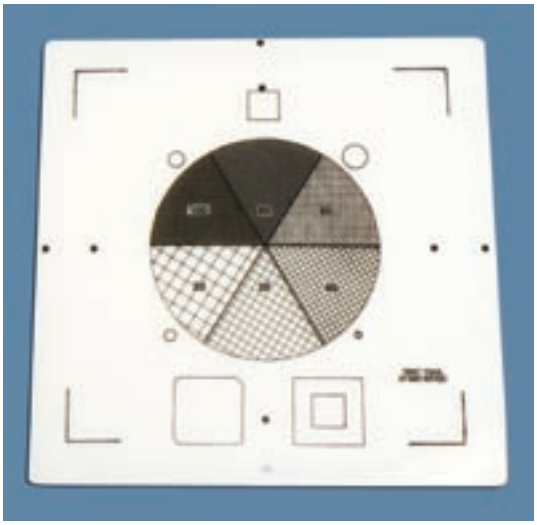
### Ordering information

**07-605-7777** CR/DR DIN Test Tool

# 07-647

## R/F QC Phantom

FLUKE® Biomedical



The 07-647 R/F QC Phantom is designed to provide the diagnostic radiologic technologist with an accurate, easy-to-use tool for evaluating the image quality and performance of standard diagnostic radiographic and fluoroscopic imaging systems.

For fine-tuning of radiographic and fluoroscopic imaging systems, it is recommended that the phantom be imaged at least monthly on all radiographic and fluoroscopic equipment. To attain the most accurate, up-to-date quality control information, a daily or weekly frequency is preferable. When used daily, the R/F QC Phantom will allow the technologist to quickly determine whether the equipment is functioning correctly. This easy-to-use phantom allows the user to complete the suggested protocol in approximately five minutes or less, when used on a standard R/F system. Once the phantom is imaged, simply graph the results to determine any trends that may indicate a degradation of imaging system performance, such as a steady but slow change in the fluoro kVp or in the radiographic mAs.

| | |
|---|---|
| **Dimensions** (WxDxH) | 17.78 cm x 17.78 cm x 1.42 cm (7 in x 7 in x 0.56 in) |
| **Weight** | 0.5 kg (1.1 lb) |

### Key features

- Designed specifically with the radiologic technologist in mind
- Provides an accurate overall evaluation of image quality consistency
- Ideal for use in determining subtle degradation in imaging performance
- Average test time is less than 5 minutes per unit
- Verifies fluoroscopic monitor contrast and brightness adjustment
- Includes pie-shaped wedges of varying mesh sizes: 20#, 30#, 40#, 60#, 80#, and 100# L/in, for evaluating high-contrast performance
- Surrounding the mesh are four low-contrast "masses" of different diameters: 2 mm, 4 mm, 6 mm, and 8 mm
- At one edge of the phantom is a small "density difference" patch, for a measure of contrast on the films
- At the opposite edge of the phantom are two monitor adjustment squares, each having a low-contrast square insert
- The phantom contains a 1 mm copper attenuator which allows it to simulate the attenuation of an average adult
- At the corners of the test tool are lines for aligning the light field
- QC charts are provided for plotting both the radiographic and fluoroscopic results
- Along the sides of the test tool are beads 1 cm inside and outside of the lines started in the corners

### Ordering information

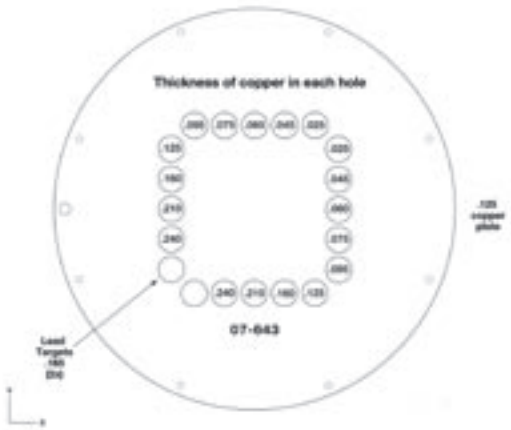
**07-647** R/F QC Phantom

# 07-643

## Contrast Imaging Phantom

FLUKE® Biomedical

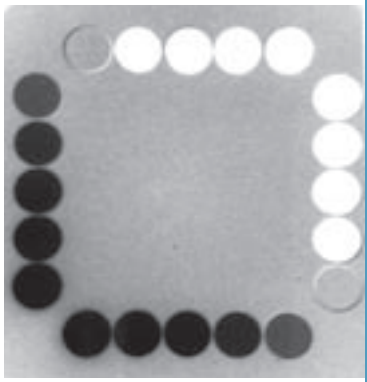
The 07-643 Contrast Imaging Phantom is an accurate, easy-to-use, indispensable tool for evaluating image quality and determining that the imaging system is operating at its full potential. It will immediately let you know if there's a problem.




Diagram

### Key features

- Provides the ability to simultaneously check the dynamic range of the video system
- Allows users to evaluate during all fluoro modes—pulsed, non-pulsed, etc.
- Provides the ability to check film range and density



X-ray image

## Specifications

| | |
|---|---|
| **Dimensions** (WxDxH) | Outside diameter: 23 cm (9.05 in) |
| | Thickness: 1.28 cm (0.5 in) |
| **Weight** | 1.26 kg (2.8 lb) |

### Ordering information

**07-643** Contrast Imaging Phantom

# 07-653

## Fluoroscopic Imaging Test Phantom

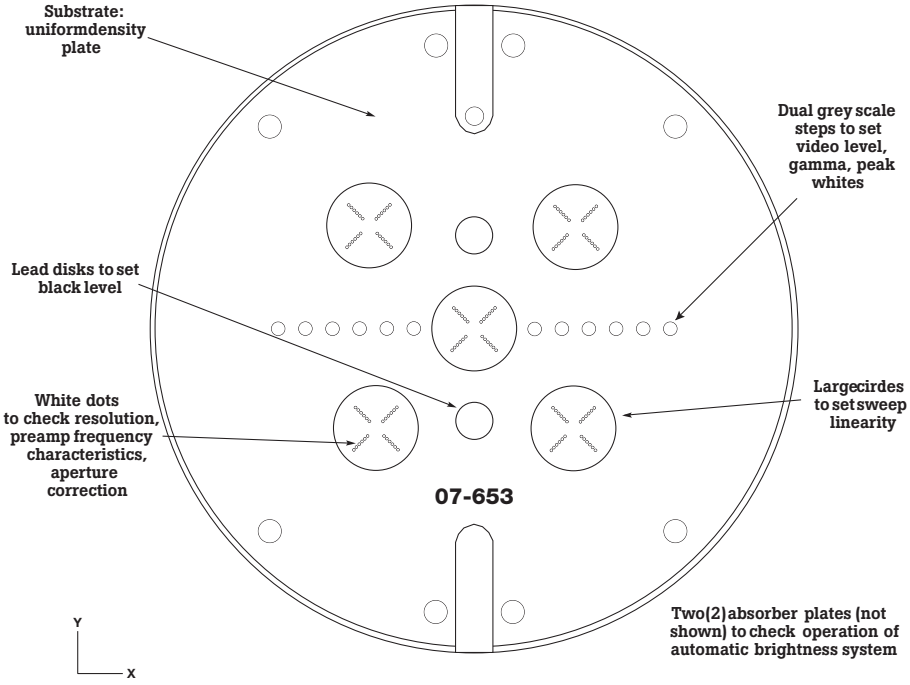
Ensure the optimum performance of your fluoroscopic system with the 07-653 Fluoroscopic Imaging Test Phantom.

This compact, versatile, and extremely easy-to-use phantom is inventively designed to enable you to evaluate, adjust and optimize fluoro video cameras, brightness systems and image processing systems. Its proven design makes it ideal for use by x-ray service engineers.

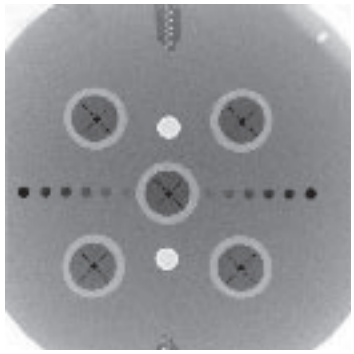
### Key features

Provides a test pattern enabling the precise adjustment of many critical parameters of the fluoroscopic system:

- Video level, contrast, peak whites, black level
- Shading or vignetting correction
- Automatic brightness
- Sweep linearity
- Frequency response, aperture correction


Substrate: uniformdensity plate
Dual grey scale steps to set video level, gamma, peak whites
Lead disks to set black level
White dots to check resolution, preamp frequency characteristics, aperture correction
Largecirdes to set sweep linearity
07-653
Two(2)absorber plates (not shown) to check operation of automatic brightness system
Y
X

Phantom diagram



X-ray image

## Specifications

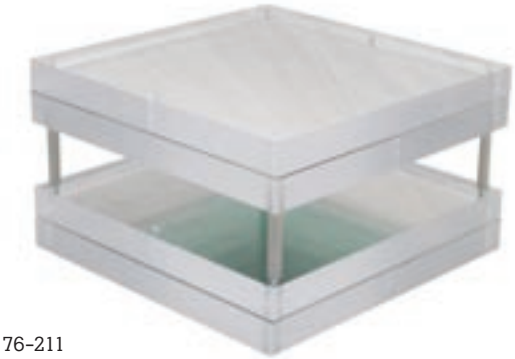
| | |
|---|---|
| **Outside diameter** | 22.78 cm (8.97 in) |
| **Thickness** | 1.28 cm (0.5 in) |
| **Weight** | 1.86 kg (4.1 lb) |

### Ordering information

**07-653** Fluoroscopic Imaging Test Phantom

# 76-2 Series

## Diagnostic X-Ray Phantoms



76-211

76-212

76-213

76-214

JCAHO requires that x-ray exposure measurements be determined for commonly used projections in all radiographic suites. In order to provide this information when using automatic exposure control (AEC) or automatic brightness control (ABC) systems, specially designed phantoms must be used. Attenuating material must be used between the source and AEC or ABC detectors. Since these detectors are energy dependent, measurement of skin entrance exposure requires the use of patient-equivalent phantoms for meaningful results.

AAPM Report No. 31 recommends the use of four unique phantoms for use in diagnostic x-rays. Fluke Biomedical's 76-2 Series phantoms meet this need. These acrylic and aluminum phantoms are patient-equivalent and are specifically designed to conform to the AAPM recommendations.

### Key features

- Phantoms conform to AAPM recommendations contained in Report No. 31, "Standardized Methods for Measuring Diagnostic X-Ray Exposure"
- Patient-equivalent acrylic and aluminum phantoms provide the necessary attenuation between the source and AEC or ABC detectors
- Helps you comply with JCAHO requirements for radiographic exposure measurements
- These phantoms are recommended in AAPM Report No. 60, "Instrumentation Requirements of Diagnostic Radiological Physicists"

# 76-2 Series

## Diagnostic X-Ray Phantoms

FLUKE® Biomedical

## Specifications

| | |
|---|---|
| **76-211** | |
| **Dimensions** (WxDxH) | (4) 25 cm x 25 cm x 2.54 cm clear acrylic sheets |
| | (1) sheet of 25 cm x 25 cm x 1 mm type-1100 high-purity aluminum |
| | (1) sheet of 25 cm x 25 cm x 2 mm type-1100 high-purity aluminum |
| **Weight** | 8 kg (17.5 lb) |
| **76-212** | |
| **Dimensions** (WxDxH) | (5) sheets of 25 cm x 25 cm x 2.54 cm and (1) sheet of 25 cm x 25 cm x 5.08 cm clear acrylic to achieve a 17.78 cm thick phantom |
| **Weight** | 17 kg (37 lb) |
| **76-213** | |
| The Skull Phantom has the same configuration as the 76-211, but without the air gap. | |
| **Dimensions** (WxDxH) | Center sheet: 25 cm x 25 cm x 5.08 cm clear acrylic |
| **Weight** | 12 kg (26.5 lb) |
| **76-214** | |
| **Dimensions** (WxDxH) | (1) 25 cm x 25 cm x 1 mm piece of high-purity alloy aluminum sandwiched between (2) sheets of 25 cm x 25 cm x 2.54 cm clear acrylic |
| **Weight** | 4.5 kg (10 lb) |
| **76-215** | |
| This kit contains all the components needed to make any one of the phantoms on this page | |
| **Dimensions** (WxDxH) | (5) 25 cm x 25 cm x 2.54 cm thick acrylic sheets |
| | (1) 25 cm x 25 cm x 5.08 cm thick acrylic sheet |
| | (1) 25 cm x 25 cm x 1 mm thick aluminum sheet |
| | (1) 25 cm x 25 cm x 2 mm thick aluminum sheet |
| | (1) 7 cm x 25 cm x 4.5 mm thick aluminum sheet |
| | Spacers for a 5.08 cm air gap |
| **Weight** | 15.3 kg (34 lb) |

### Included accessories

**76-211**

Spacers to provide a 5.08 cm air gap

**76-212**

In order to provide additional attenuation in the spinal region, a 7 cm x 25 cm x 4.5 mm thick piece of high-purity alloy aluminum is included.

### Ordering information

**76-211** Chest X-Ray Phantom

**76-212** Abdomen/Lumbar Spine Phantom

**76-213** Skull X-Ray Phantom

**76-214** Extremity X-Ray Phantom

**76-215** Make-Your-Own-Phantom Modular Kit

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Biomedical

# 76-025

## CDRH Dental Image Quality Test Tool

The Nationwide Evaluation of X-Ray Trends (NEXT*) dental protocol has been issued to provide guidelines for quality control procedures for diagnostic dental radiography. In order to perform these procedures, a suitable phantom was developed: the 07-625 CDRH Dental Image Quality Test Tool.

The JCAHO requires certain standards to be met regarding radiographic quality control. The 07-625 CDRH Dental Image Quality Test Tool facilitates compliance with these standards, since the standards were compiled using a prototype of this phantom.

The 07-625 CDRH Dental Image Quality Test Tool is designed specifically for testing the functionality of dental x-ray units and provides a means of evaluating half-value layer, determining kVp, and assessing overall image quality. It is the only dental test tool designed with dental service personnel and inspectors in mind. The test tool will significantly improve the ability of service personnel to quickly and accurately survey the image quality of the x-ray unit. The 76-025 CDRH Dental Image Quality Test Tool can also be used as a constancy check for x-ray film processing, making it the most versatile and cost-effective dental test tool available today.

Clinical imaging involves diagnosis of tooth pathology. In order to permit an accurate simulated clinical image evaluation, the test tool contains a human tooth encased in its center. The 76-025 CDRH Dental Image Quality Test Tool consists of a wooden cradle (to hold the test tool body), built-in slots (for attenuation filters), a film slot, an exposure chamber holder, and a mounting screw (for use with a tripod). The test tool comes with an aluminum step wedge that is designed for evaluating darkroom fog and consistency testing. The step wedge has two slots, one for exposing a film pack and one for evaluating darkroom fog. The film slot also ensures easy, reproducible placement of the film for consistent imaging.

To use the 76-025 CDRH Dental Image Quality Test Tool, it is necessary to establish an acceptable baseline or standard for the x-ray unit performance. The test tool should be imaged using the same technical factors that were used to establish the baseline. These images, when compared to the baseline, will allow the user to determine if image quality degradation is occurring so appropriate corrective action can be taken.

### Key features

- Designed to meet the requirements for the NEXT dental survey protocol
- Conforms to Center for Devices and Radiological Health (CDRH) specifications
- Provides a means of reproducible setup, ensuring a consistent test protocol
- Reduces the need for repeat films
- Reduces setup time
- Increases patient safety
- Minimizes chance of misdiagnosis
- Ideal for dental service engineers and inspectors

*NEXT (Nationwide Evaluation of X-Ray Trends) is a committee of the Conference of Radiation Control Program Directors (CRCPD) that oversees quality control procedures for diagnostic radiology. They issue procedure protocols and guidelines for imaging modalities.

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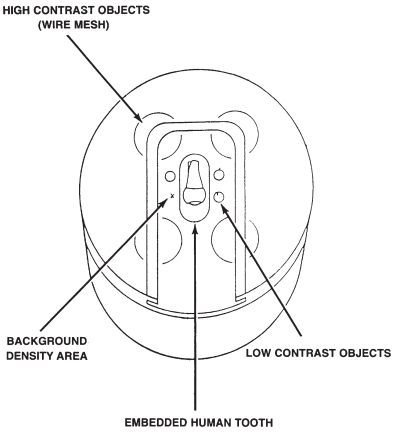
# 76-025

## CDRH Dental Image Quality Test Tool



CDRH Dental Image Quality Test Tool (76-025) set up for half value layer measurements

### Optional accessories

**76-025-4000** Aluminum Step Wedge

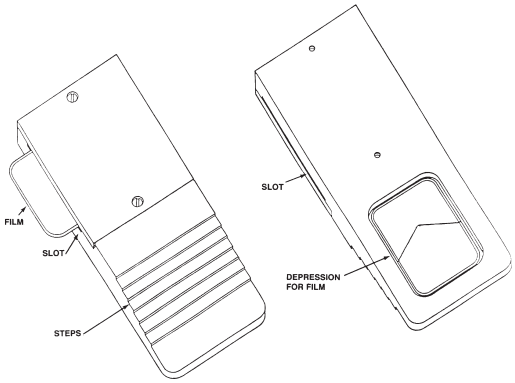
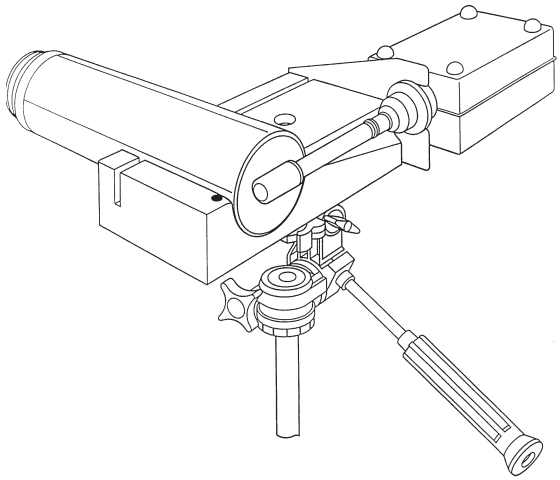



Diagram of Aluminum Step Wedge used for darkroom fog and consistency testing



CDRH Dental Image Quality Test Tool (76-025) set up for dental exposure measurement protocols

## Specifications

| | |
|---|---|
| **Materials** | Base: Wood |
| | Test tool: Acrylic |
| | Step wedge: Type-1100 aluminum |
| **Dimensions** (WxDxH) | Base: 10 cm x 20 cm x 4.9 cm (3.94 in x 7.87 in x 1.93 in) |
| | Test tool: 7.6 cm Ø x 5.5 cm long (3 cm x 2.17 cm) |
| | Step wedge: 5.1 cm x 12.7 cm x 1.3 cm |
| **Weight** | 0.88 kg (2.06 lb) |

### Included accessories

Four different copper wire meshes that have the following lines-per-inch ratios: 100, 120, 150, and 200
Four air steps for contrast and density measurements
One human tooth encased in the phantom material
One aluminum step wedge

### Ordering information

**76-025** CDRH Dental Image Quality Test Tool

**76-025-6661** Dental Image Quality Test Tool with Decayed Tooth

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# 76-606DX

## ATOM MAX
## Diagnostic Head Phantom

ATOM MAX

The 76-606DX ATOM MAX Diagnostic Head Phantom is a standard of reference for diagnostic radiology of the head. The phantom is designed to assist technical and clinical staff in the selection, monitoring, training and verification of scanning parameters common to most radiological procedures requiring fine anatomical details.

The 76-606DX provides a consistent tool for researchers, clinicians and technologists. It is ideal for determining optimum system settings, commissioning new equipment, monitoring system performance and training in dental x-ray, panoramic x-ray, CT, and cone beam CT procedures.

The phantom includes an adjustable stand for positioning within a cone beam CT or panoramic x-ray system. The jaw of the phantom is slightly opened and front teeth are vertically aligned to replicate correct positioning with a bite guide. Please note that an actual bite guide can not be positioned in this product.

The phantom is constructed of proprietary tissue equivalent materials. ATOM MAX is made of tissue simulating resins that mimic the X-ray attenuation properties of human tissue for both CT and therapy energy ranges (50 keV to 25 MeV). The 76-606DX approximates the average male human head in both size and structure. The phantom includes detailed 3D anthropomorphic anatomy including brain, bone, larynx, trachea, sinus, nasal cavities and teeth. The bones contain both cortical and trabecular separation. The teeth include distinct dentine, enamel and root structure including the nerve. The sinus cavities are fully open.

### Key features

- Our most realistic maxillofacial phantom for dental cone beam CT and panoramic x-ray
- Includes detailed anatomical features
- Frankfurt plane identified to ensure proper alignment
- Tissue equivalent from 50 keV to 25 MeV
- Positioning stand with six degrees-of-freedom
- Carrying case included
- Four-year warranty

**Simple to set up and easy to use**

The 76-606DX stand allows accurate phantom positioning. The included stand is adjustable in the x-y-z axes as well as allowing rotations about each of these axes. The head easily screws onto the stand and locks into place.

**Capabilities and applications**

- Commission x-ray, panoramic x-ray, CT, and cone beam CT systems
- Learn how to properly position head for optimal images
- Test reconstruction techniques and algorithms for implant planning and maxillofacial reconstruction
- Train and evaluate personnel during implementation of new equipment and techniques
- Validate consistency of image quality

## Specifications

| | |
|---|---|
| **Overall size** (phantom only) | 22.9 cm x 22.9 cm x 29.2 cm (9 in x 9 in x 11.5 in) |
| **Phantom weight** | 5 kg (11 lb) |
| **Stand weight** | 3.2 kg (7 lb) |
| **Shipping weight** | 13.2 kg (29 lb) |

### Included accessories

Positioning stand with soft sided carrying case and phantom carrying case

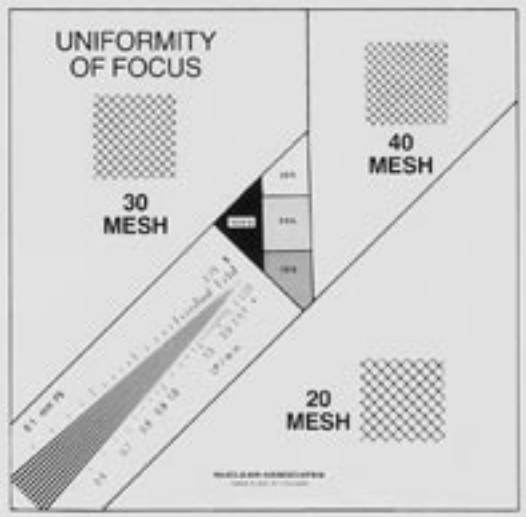
### Ordering information

**76-606DX** ATOM MAX Diagnostic Head Phantom

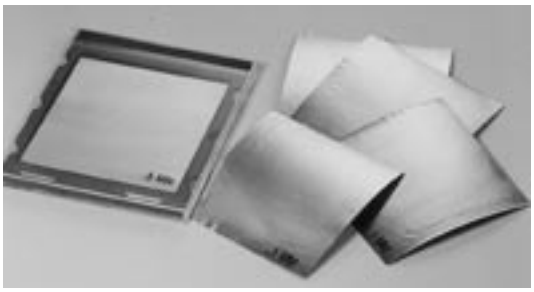
# 07-656 and 07-434

## Cardiac Digital Imaging Phantom and Ultra-High Purity HVL Attenutators

FLUKE® Biomedical




07-656



07-434

**07-656 Cardiac Digital Imaging/Cine-Video Quality Control Phantom and Patient Identifier***
This patient-equivalent phantom provides permanent patient identification information (required by the ACC), as well as quality control checks for digital imaging (when exposed on the cine film or videotape at the beginning of the study, before the patient is placed on the table). In addition, quality control test of resolution, density and contrast, and uniformity of focus.

**07-434 Ultra-High Purity HVL Attenutators**
Because type-1100 aluminum is only 99.0 % pure, it has some impurities that can give a HVL value that is 7.5 % lower than those measured with pure aluminum.

When doing HVL measurements with a mammography unit, it is recommended that the highest purity aluminum be used. This set of six attenuators satisfies this recommendation, because they are 99.9 % pure (type-1145).

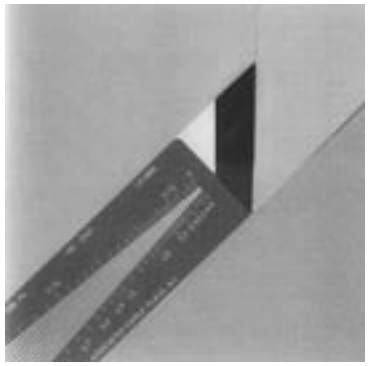
### Key features

**07-656**

- Recommended as part of the Image Compression Study being conducted by the American College of Cardiology (ACC) DICOM Committee
- Selected by the ACC as the image quality criteria for digital imaging

**07-434**

- Recommended for mammography
- 99.9 % pure for accurate HVL measurements



07-656

## Specifications

| | |
|---|---|
| **07-656** | |
| **Dimensions** (WxDxH) | 21.5 cm x 21.5 cm x 1.2 cm (8.5 in x 8.5 in x 0.375 in) |
| **Weight** | 1.3 kg (3 lb) |
| **07-434** | |
| **Dimensions** (WxDxH) | 10 cm x 10 cm x 0.1 mm (4 in x 4 in x 0.004 in) |
| **Weight** | 0.06 kg (0.15 lb) |

### Included accessories

**07-656**
High contrast resolution test pattern, four-step density contrast test section, mesh screen (20, 30, 40 mesh) to test for uniformity of focus and a 0.0937 inch thick copper plate

### Ordering information

**07-656** Cardiac Digital Imaging/ Cine-Video QC Phantom and Patient Identifier

**07-434** Ultra-High Purity HVL Attenuators, set of 6

**07-430** Standard Aluminum HVL Attenuators, set of 11

**07-431** Copper HVL Attenuators, set of 10

*Designed by Joel E. Gray, Ph.D., Professor Emeritus, Department of Diagnostic Radiology, Mayo Clinic®, Rochester, MN 55905. Manufactured under licensing agreement with Mayo Foundation for Medical Education and Research.

FLUKE®
Biomedical

# 07-645

## Fluoro-Test™ Tool*

The 07-645 Fluoro-Test Tool is a fluoroscopic contrast resolution device that employs a target arrangement designed to reduce ambiguity and difficulty associated with employing a sequential array of targets with small differences in contrast between adjacent targets.

With the 07-645 Fluoro-Test target plates, the user focuses on a subset of three targets at a given time. In each subset or column, large differences (approx. 3 %) are present between adjacent targets and it is easy to decide if a target is visualized or not. The threshold contrast for a plate is the lowest of the values observed for the three columns of targets, and a contrast resolution precision of 0.5 % is obtained by the sequential use of the two plates. When imaged at 80 kVp with 2 mm of Cu beam attenuation, the targets of Plate A range in contrast from 1 % to 8 % in 1 % increments. Likewise, the targets of Plate B range from 0.5 % to 7.5 %. Tables of target contrast versus kVp permit the user to determine target contrast (and therefore threshold contrast resolution) at other fluoroscopic tube potentials.

### Key features

- Designed to yield a quantitative assessment of fluoroscopic threshold contrast

## Specifications

| 07-645 | |
|---|---|
| **Dimensions** (WxDxH) | Two 6 in x 6 in x 0.25 in (6.1 mm) thick aluminum plates, with each plate containing an array of 1.1 cm targets of varying contrast |
| | Three 6 in x 6 in x 1 mm thick copper attenuator sheets |
| **Weight** | 1.42 kg (3.15 lb) |

* Manufactured under licensing agreement with UAB Research Foundation, University of Alabama at Birmingham, Alabama.

The development of the 07-645 is based on the work of A. J. Wagner, G. T. Barnes and X. Wu, "Assessing Fluoroscopic Contrast Resolution: A Practical and Quantitative Test Tool," Medical Physics, 18 (1991), 894-899.

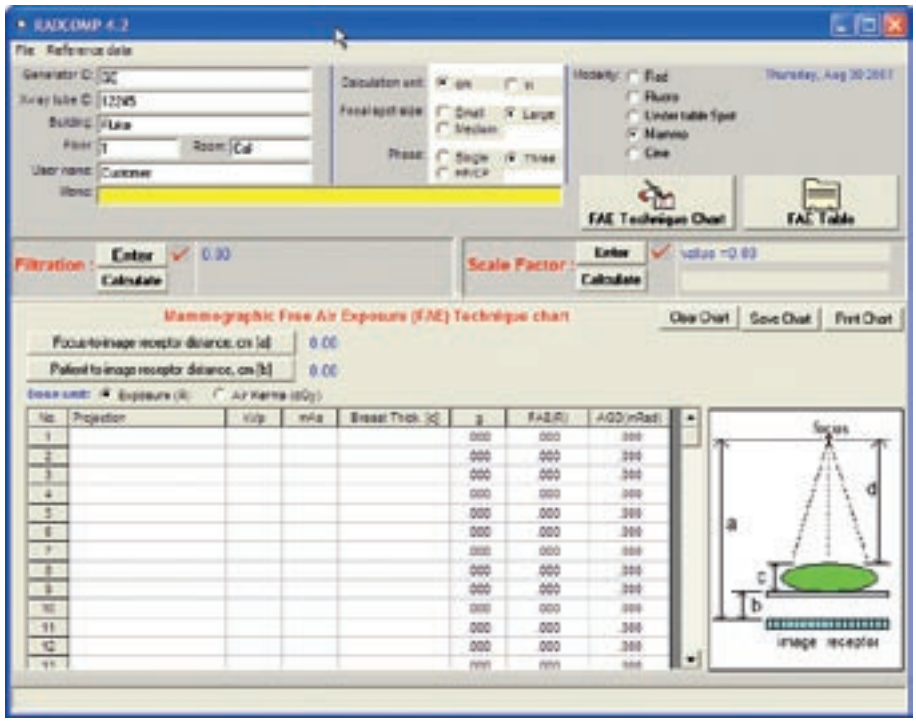
### Ordering information

**07-645** Fluoro-Test Tool

FLUKE®
Biomedical

# 07-101-2000

## RADCOMP X-Ray Entrance Skin Exposure Software




### Key features

- Eliminate the tedious and time-consuming calculations you are now doing to comply with patient safety needs
- RADCOMP software will generate the required table of patient entrance skin exposures quickly, conveniently and accurately
- RADCOMP is so accurate, that its output was adopted by NCRP 102
- RADCOMP's simplicity lends itself to use by anyone (although a qualified physicist must review the results for JCAHO compliance)

The 07-101-2000 RADCOMP can be used for x-ray, fluoroscopy, mammography and cardiac cath. The user inputs typical projections used for each procedure, aluminum filtration, kVp, mAs, etc. and the RADCOMP program will make all the calculations quickly and accurately. In addition, RADCOMP can tabulate "technique charts."

RADCOMP generates a unique "scale factor" for each individual x-ray tube. It is derived by making only three or four exposure measurements at different kVp settings. RADCOMP automatically matches these measurements against reference data. This reference data was obtained under controlled conditions and does not require user input. The "scale factor" is used by RADCOMP, together with simple user input (kVp, mAs, and focus-to-skin distance) to yield free-air-entrance skin exposure (ESE), fluoroscopic exposure rate, or average glandular dose for mammography. The output can be selected in units of "R" or "air kerma."

### Ordering information

**07-101-2000** RADCOMP X-Ray Entrance Skin Exposure Software

# 07-638 and 07-614-8080

## Fluoro Contrast Test Disks and Adult Cine Attenuator

07-638

07-614-8080

**07-638 Fluoro Contrast Test Disks**

Measuring the percent contrast using the Fluoro Contrast Test Disks can be performed annually and/or whenever a new image-intensifier tube is installed. This test should be part of the QC testing program of the cine imaging chain. Fluoro Contrast Test Disks make performing all required measurements easy. The disks satisfy NEMA® (National Electrical Manufacturers Association) requirements for image intensifiers and facilitate compliance with NEMA Standard XR-16.

To measure percent contrast, a disk is taped to the center of the fluoro grid during a 2 to 3-second cine run, using the Adult Cine Attenuator in the beam. The resulting optical densities to the side and behind the image of the disk (on the developed cine frames) are then measured with a calibrated densitometer, such as our Hand-Held Deluxe Digital Clamshell Densitometer (07-443).

**07-614-8080 Adult Cine Attenuator**

The input radiation level of a fluoroscopic unit can be measured directly by placing an x-ray ion chamber behind the antiscatter grid and then imaging the appropriate cine attenuator. The adult model has a 2.4 mm copper plate sandwiched between 0.125 in thick acrylic sheets.

The attenuator is designed to simulate an average adult patient in regard to the exposure factors required by the ABC system. The final optical density on the processed frames is controlled by the size of the aperture in the diaphragm, which is located directly in front of the cine camera lens. To determine the optimal on-frame optical density, a series of cine runs are made using different sized apertures in the beam.

## Specifications

| | |
|---|---|
| **07-638** | |
| **Disk thickness** | 0.125 inch thick lead, sandwiched between two 0.125 inch thick white acrylic plates |
| **07-614-8080** | |
| **Dimensions** | 17.8 cm x 17.8 cm (7 in x 7 in) |
| **Weight** | 1.42 kg (3.15 lb) |

### Key features

**07-638**

- Designed specifically for monitoring the percent contrast of the image-intensifier tube/lens system
- For quality control testing of the cine imaging chain
- Testing can easily be performed by the in-house technical staff

**07-614-8080**

- Help measure fluoro input radiation levels
- Simulates average adult patient

### Optional accessories

**07-638**

**07-443** Handheld Deluxe Digital Clamshell Densitometer

### Included accessories

**07-638**

Each set consists of six disks, one each of the following diameters: 1.875 in, 2.125 in, 2.375 in, 2.625 in, 2.875 in, and 3.375 in

### Ordering information

**07-638** Fluoro Contrast Test Disks, set of six

**07-614-8080** Adult Cine Attenuator, 8 in x 8 in

# 07-444

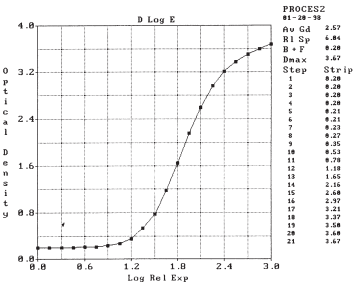
## "The Little Genius" Scanning Densitometer

The 07-444 "Little Genius" Scanning Densitometer stands head and shoulders above all other densitometers when it comes to performance, reliability and economy. The only handheld scanning densitometer in the industry with built-in scanning and single-point (spot) measurement capability, it literally does the work of two densitometers.

The 07-444 measures and stores daily film data for up to 20 different x-ray film processors for 31 days in its own built-in memory. Use it to generate and print control charts and D-Log-E curves directly to a printer without using external software and a computer. Set base-line (target) and tolerance levels for each control chart parameter either manually or automatically by scanning and averaging up to 9 different film strips.

### Key features

- Built-in scanning and single-point (spot) measurement capability, it literally does the work of two densitometers
- Quickly and easily generates control charts and D-Log-E curves, without the use of external software
- Saves time
- Increases accuracy of readings
- Provides vital information in seconds
- Includes built-in scanning and single-point measurement capabilities
- Available with AutoSTPP X-Ray Film Processor QC Software




D-Log-E curve generated by "The Little Genius" without external software

## Specifications

| | |
|---|---|
| **Measuring range** | 0 to 4 OD units |
| **Accuracy** | 0 to 3 OD ± 0.02 OD units; 3 to 4 OD ± 1 % |
| **Repeatability** | ± 0.02 OD units |
| **Power requirements** | 6 AA batteries, 1.5 V alkaline; 110 V ac with ac power converter |
| **Spectral response** | Centered at 540 nm |
| **Aperture size** | 1 mm and 2 mm |
| **Dimensions** (WxDxH) | 8.1 cm x 7 cm x 18 cm (3.2 in x 7.1 in x 2.75 in) |
| **Weight** | 1.3 kg (2.8 lb) |

### Optional accessories

**802013** RS-232 Interface Cable, 2 m (7 ft)
**169072** 9-Pin Adapter
**169071** 25-Pin Adapter
**88-444** Non-Powered Serial Parallel Converter

**Available ac adapters for (specify with order)**
**14-301** 110 V ac, 9 V dc, 500 mA, USA and Japan
**14-399** 230 V ac, 9 V dc, 500 mA, Europe
**14-415** 230 V ac, 9 V dc, 500 mA, UK
**14-415 and 14-416** adapter 230 V ac, 9 V dc, 500 mA, Australia

### Included accessories

**07-444**
**802013** RS-232 Interface Cable
**169072** 9-Pin Adapter
**169071** 25-Pin Adapter

**07-446**
**07-444-1CD** AutoSTPP X-Ray Film Processor QC Software
**802013** RS-232 Interface Cable
**169072** 9-Pin Adapter
**169071** 25-Pin Adapter

### Ordering information

**07-444** "The Little Genius" Scanning Densitometer
**07-446** "The Little Genius" Scanning Densitometer

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# 07-443

## Handheld Deluxe Digital Clamshell Densitometer

Get all the benefits of state-of-the-art features in a compact, handheld unit. The 07-443 Handheld Deluxe Digital Clamshell Densitometer has today's most-wanted features for "go-anywhere" quality control testing...from darkroom to darkroom, and from lab to field.

It's easy to use. Just lift the "shell" and insert the test film; close the "shell" and press the READ button. The measured optical density appears on the three-digit liquid crystal display. The self-contained light source makes it convenient to use, anywhere.

### Key features

- Features a self-contained light source
- Fast and accurate results
- Lightweight and portable
- Reads grayscale up to 4 OD
- Two aperture choices: 1 mm and 2 mm
- Easy-touch pads
- Battery operated
- Easy read display

## Specifications

| | |
|---|---|
| **Range** | 0 to 4.0 OD |
| **Accuracy** | ± 0.02 OD |
| **Reproducibility** | ± 0.01 OD |
| **Temperature range** | 10 °C to 40 °C (50 °F to 104 °F) |
| **Apertures** | 1 mm and 2 mm |
| **Measuring length** | Throat: 135 mm (5.3 in) |
| **Zero range** | Auto zeros to density 0.0 |
| **Sensor** | High-efficiency silicon photodiode |
| **Controls** | Zero pushbutton: zeros unit |
| | Power on/off switch |
| | READ pushbutton: initiates READ sequence |
| | Calibration control: screwdriver adjustable 20-turn potentiometer used to calibrate against a known step tablet |
| **Display** | Three-digit, 0.5 in LCD with a low-battery indicator |
| **Light source** | When turned on during measurement, provides extremely long life with minimum spectral and intensity degradation. Reduces heating to a minimum |
| **Power requirements** | Four 1.5 V AA batteries (approx. 3,000 exposures) |
| **Dimensions** (WxDxH) | 8.1 cm x 18 cm x 6.1 cm (3.2 in x 7.1 in x 2.4 in) |
| **Weight** | 0.82 kg (1.81 lb) |

### Optional accessories

**87-443-1000** Battery Charger
**87-443-2140** Battery and Charger Kit, includes four AA NiCad batteries and one battery charger
**89-443** Carrying Case

### Included accessories

**010128** Five-Step Density Tablet
**89-443** Carrying Case

### Ordering information

**07-443** Handheld Deluxe Digital Clamshell Densitometer

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# 07-417

## Handheld Dual-Color Sensitometer

This compact, precision instrument is ideal for maintaining consistent, high-quality film processing. By evaluating control films on a daily basis, the technologist can identify processor variations before they affect clinical radiographs. Also, processing conditions in multiprocessor departments may be standardized. In the past, this was difficult in departments using varied film-screen combinations in different areas. With this sensitometer, proper exposure of either blue- or green-sensitive x-ray film is easily accomplished, with no need for internal adjustments.

The Handheld Dual-Color Sensitometer features a 21-step density wedge with 0.15 OD increments. The 21 density-gradient steps are numbered for convenience. An innovative, dual-color, electroluminescent light source provides precisely-controlled repeatable exposures. The desired color is selected with a front-panel switch.

To make an exposure, the platen is raised and a sheet of film is inserted beneath it until the film stops are reached. The platen is lowered and the exposure switch is depressed. An audible buzzer is activated during the exposure. To prevent double-exposures, a two-second delay is engaged before the next exposure can be made. When battery replacement becomes necessary, the unit will not expose film. Battery life is approximately 10,000 exposures.

Processor variations are monitored by comparing the control film to previously processed films. Speed, contrast, and base-plus-fog values can be graphically plotted for easier comparison.

### Key features

- Helps maintain optimum film processing conditions
- Easy selection of blue or green light emission
- Lightweight, portable, battery-operated
- Repeatability: ± 0.04 OD log exposure from unit-to-unit
- Stability: ± 0.02 OD log exposure per year at 10 °C to 45 °C
- Numbered, 21-step density wedge

## Specifications

| | |
|---|---|
| **Light source** | Dual-color electroluminescent |
| | Blue 455 nm ±10 nm; green 520 nm ± 10 nm |
| **Repeatability** | ± 0.04 OD log exposure from unit to unit |
| **Stability** | ± 0.02 OD log exposure per year at 10 °C to 45 °C |
| **Exposure area** | 21 steps, each 5 mm x 10 mm |
| **Tablet densities** | 0.05 OD to 3.05 OD in 0.15 OD increments |
| **Exposure time** | Adjustable, 50 ms to 500 ms typical |
| **Exposure adjustment** | Separate external screwdriver adjustments ± 0.5 OD on each color |
| **Controls** | Push-to-expose button: buzzer monitor and two-second delay to prevent double exposures |
| | Blue/Green rocker switch |
| | Power switch: none required. Unit draws no power on standby |
| **Power requirements** | Two 9 V alkaline transistor batteries. Optional ac power converter. Approximate battery life 10,000 exposures |
| **Dimensions** (WxDxH) | 13.34 cm x 19.37 cm x 9.21 cm (5.25 in x 7.625 in x 3.625 in) |
| **Weight** | 1.14 kg (2.5 lb) |

### Optional accessories

**89-417** Carrying Case

**Available ac adapters for (specify with order)**

**14-301** 110 V ac, 9 V dc, 500 mA, USA and Japan

**14-399** 230 V ac, 9 V dc, 500 mA, Europe

**14-415** 230 V ac, 9 V dc, 500 mA, UK

**14-415 and 14-416** Adapter 230 V ac, 9 V dc, 500 mA, Australia

### Ordering information

**07-417** Handheld Dual-Color Sensitometer

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# 07-402

## Portable Digital Thermometer

This 07-402 Portable Digital Thermometer is a battery-powered unit with a detachable immersion probe. Temperature readings appear in Centigrade or Fahrenheit with ± 0.5 % accuracy. The LED display eliminates problems that can result from the misreading of stem-type thermometers.

Detachable immersion probes are time-savers for x-ray departments that have several film processors. The use of multiple probes, each remaining in a specific tank, also eliminates the possible cross-contamination of chemicals.

CE

The 07-402 includes many convenient features and capabilities. You can quickly and easily display the lowest and highest temperatures measured by the probe since the unit was turned-on. Our digital thermometer also enables you to "freeze" the current temperature reading on the display. The thermometer display can be easily illuminated, making it perfect for use in the darkroom. You can also program the 07-402 for auto or manual shut-off.

The 07-402 Portable Digital Thermometer is a shock resistant, solid-state unit that needs no adjustments to maintain accuracy. Calibration is traceable to the National Institute of Standards and Technology (NIST)*. The unit includes a high-impact plastic case with a recess for storing one probe, and is equipped with a power jack that will accept the optional ac power supply. The jack should be used when the unit will be in use for extended periods of time (in order to prevent battery failure).

### Key features

- Displays minimum/maximum readings
- Hold/freeze function
- Auto shut-off
- Battery eliminator jack for a 9 V dc converter
- Checks film processor solution temperatures quickly and accurately
- Large, easy-to-read, backlit digital display of temperature in Centigrade or Fahrenheit
- Accuracy: ± 0.5 %
- State-of-the-art detachable immersion probe saves time and allows use of multiple probes with one display unit

## Specifications

| | |
|---|---|
| **Temperature range** | -40 °C to 150 °C (-40 °F to 300 °F) |
| **Resolution** | 0.1 °F |
| **Accuracy** | ± 0.5 % over entire range |
| **Display** | Four-digit LED, plus decimal point |
| **Battery** | Standard 9 V alkaline or equivalent |
| **Dimensions** | Thermometer (WxDxT): 7.6 cm x 20.3 cm x 2.9 cm (3 in x 8 in x 1.125 in) |
| | Display area: 5.1 cm x 2.4 cm (2 in x 0.94 in) |
| | Probe: 15.3 cm long (6 in long) |
| **Weight** | 3.38 kg (7.44 lb) |

*Factory re-calibration available.

### Optional accessories

**07-403** Immersion Probe
**07-401** Waterproof Probe, will not be damaged in chemistry or water

### Included accessories

High-impact plastic case

### Ordering information

**07-402** Portable Digital Thermometer with one probe

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# 07-424

## Digital Densitometer

The 07-424 Digital Densitometer is an easy-to-use precision instrument that quickly measures the optical density of film. And with its optional RS-232 interface, you have the capability to automatically transfer the data to a computer for storage and retrieval.

Constructed of rugged steel and compact enough to fit on any crowded worktable, it offers exceptional accuracy (± 0.02 optical density). The optical density value is displayed in bright LED numerals on the detector arm. The sample table is 6.125 in x 10.5 in with a 4.75 in x 5.5 in illuminated section. It will accommodate film up to 14 in x 17 in and provides ample room for positioning any selected area under the detector.

The detector is a hermetically-sealed silicon photodiode. The detector lamp is at full brilliancy only during the actual measurement, thus preventing heating problems and ensuring very long lamp life with minimum wavelength shift or other degradation. When necessary, the lamps are easily replaced. The densitometer includes a five-step optical density tablet.

### Key features

- Large illuminated surface
- Density range is 0 D to 4.5 D
- Three apertures: 1 mm, 2 mm, and 3 mm
- RS-232 interface available
- Includes a five-step optical density tablet

## Specifications

| | |
|---|---|
| **Density range** | 0 D to 4.5 D |
| **Accuracy** | ± 0.02 density. Reference tablet supplied |
| **Response time** | Two seconds at 3 density |
| **Zero drift** | Negligible |
| **Apertures supplied** | 1 mm, 2 mm, and 3 mm D. Anodized aluminum |
| **Throat** | 21 cm length (8.2 in). Easily measures to center of 35.6 cm x 43 cm (14 in x 17 in) film |
| **Illuminated table** | 12 cm x 14 cm (4.75 in x 5.50 in) |
| **Diameter of aperture holder** | (area obscured) 0.73 in |
| **Spectral response** | 5000 A to 5500 A peak of bell-shaped curve |
| **Detector illumination** | Incandescent lamp with spectral compensation filter. Lamp is at full brilliancy only during measurement. |
| **Table illumination** | Four #37, low voltage, wedge-base lamps |
| **Digital readout** | Three 0.4 inch high light-emitting diode (LED) numerals on detector arm. |
| **Detector** | Hermetically-sealed, silicon photodiode. |
| **Zero control** | Allows wide range adjustment for different apertures and density subtraction. |
| **Power** | 110/220 V, 50/60 Hz |
| **Dimensions** (WxDxH) | 16 cm x 34 cm x 12.5 cm (6.3 in x 13.4 in x 4.9 in) |
| **Weight** | 3.2 kg (7 lb) |

### Optional accessories

**89-424** Carrying Case
**07-413** Apertures, set of three
**010037** Step Tablet
**802013** RS-232 Interface Cable, 2 m (7 ft)
**169072** 9-Pin Adapter
**169071** 25-Pin Adapter

### Included accessories

**010128** Step Tablet

### Ordering information

**07-424** Digital Densitometer,
**07-424-220** Digital Densitometer, 220 V
**07-440** Digital Densitometer with RS-232 interface
**07-440-2200** Digital Densitometer with RS-232 interface, 220 V

# 77-201TR to 77-406TS

## MAXANT TECHLINE Illuminators

FLUKE® Biomedical

Two over two panel recess mounted unit (77-222TR)

The MAXANT TECHLINE Illuminator is a universal body design available in multiple "instant on" lighting configurations, including the TECHLINE 200, 300 and 400 series. Offered in configurations from a single panel through six-over-six panels, surface and recess mounted, TECHLINE provides maximum quality and flexibility for radiological film interpretation.

TECHLINE is a high-end line that boasts the EvenVue Reflector System for uniform lighting, Cluster Switching for optimal convenience, and many other standard features.

**Applications**

TECHLINE is ideal for use in hospital and medical high-volume environments. It incorporates the most commonly requested features and benefits desired by diagnostic imaging professionals.

### Key features

- Thin 3.375 in profile
- Sturdy steel construction
- TECH-GRIP, roller gravity film holding system
- Centralized cluster switching
- Continuous bottom film ledge
- Minimal 1.8 in separation between tiers of two tiered fixtures
- Engineered design easily serviced
- Baked white enamel finish
- UL listed and CSA approved
- Film activated micro switch
- Dual intensity (available on TECHLINE 300 and 400 series only)
- Multi-panel master switch
- Surface mount hardwired
- Hospital-grade plug
- Diagnostic viewing center

## Specifications

| | |
|---|---|
| **Body construction** | 18 gauge welded steel construction, 3.375 inch deep body. |
| **Ballasts** | Safety rating: All ballasts are UL listed and C.S.A. approved rapid start, low leakage, thermally protected, Class P type. |
| | These ballasts have self starting reliability exceeding 10,000 cycles with an anticipated 50,000 hours of operating life. |
| **Line cord and plug** | Each surface mounted fixture comes standard with a grounded chassis, 7 inch line cord and NEMA 5-15P 2-pole, 3 wire ground. |
| **Film grip** | Roller gravity film holding system accommodates all film thickness variations. This grip will not scratch or tear film. Requires no field adjustments. Open sides facilitate viewing of oversize film. |
| **Continuous bottom film ledge** | Allows for the placement of small film formats on the top and bottom of viewing area. |
| **Finish** | Powder coated white finish is bonded to all steel surfaces to provide durable chip and wear resistant outer surface. Highly reflective inner finish provides optimal light distribution. |
| **Diffusing panel** | 0.125 inch shatter resistant, UL listed translucent thermoplastic. |
| **Switches** | The standard two position rocker switch provides manual ON/OFF lighting for each viewing area. |
| **Engineered two tiered fixture design** | Two tier configurations have a minimal separation of 1.8 inch between tiers allowing for convenient top to bottom image comparison. |
| **Engineered design for easy servicing** | Viewing panel is easily removed without tools. Fixture is serviceable without having to remove fixture from wall. Individual wireway panels can be easily removed for direct access to problem panels. |
| **Cluster switching** | Individual rocker control switches are a standard feature and are centrally located at the bottom of the fixture, configured in the same layout as the viewing panels they control. |

# 77-201TR to 77-406TS

## MAXANT TECHLINE Illuminators

FLUKE® Biomedical

## Specifications

| Optional features | |
|---|---|
| **Film activated three position rocker switch** | Provides for manual ON/OFF and film activated mode which activates the viewing area when a film is inserted into the film grip |
| **Master switch** | Provided master ON/OFF control of the entire fixture |
| **Hospital grade plug** | Heavy duty plug specified in certain municipalities |
| **Surface mount hardwiring** | Single electrical power exit location on the rear of fixture allows for surface mounted fixtures to be directly wired to the wall |
| **Diagnostic viewing center angulation and corner mounting** | Angled mounting: top tier vertical and bottom tier angled at 20° maintaining centralized Cluster Switching located at bottom center of fixture which controls top and bottom tiers (see DVC information) |

### Light source and luminance

| Techline Series | Illumination levels (expected minimum cd/m²) | Amps per panel | Voltage requirements | Fluorescent lamp type |
|---|---|---|---|---|
| **Techline 200 series** | | | | |
| **Standard** | 2000 | 0.75 | 118 V, 60 Hz | (2)-F15IT8/D per panel |
| **Techline 300 series** | | | | |
| **Standard high intensity** | 3500* | 0.66 | 118 V, 60 Hz | (3)-F15T8/D per panel |
| **Optional dual intensity: low mode** | 2500 | | | |
| **Optional dual intensity: high mode** | 3500* | | | |
| **Techline 400 series** | | | | |
| **Standard high intensity** | 4000* | 0.7 | 118 V, 60 Hz | (4)-F15T8/D per panel |
| **Optional dual intensity: low mode** | 2000 | | | |
| **Optional dual intensity: high mode** | 3800* | | | |

*The noted series exceeds the American College of Radiology recommended light level of 3000 cd/m² for mammography viewing.

Published readings are 3 % less than actual test levels to allow for decreased light output as a result of normal usage.

These light levels are taken from procedures specified by the German DIN 6856 standard. Currently this is the only published standard for evaluating the luminance levels of x-ray illuminators. These levels were measured under the following conditions: an ambient temperature of 21 °C (70 °F), 118 V line voltage, and new lamps. Light levels measured in the field may vary with the local environment, including lamp age, line voltage, ambient temperature and lamp temperature. These measurements are subject to change without notice.

| Surface mounted | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Dimensions (inches) | | | 200 series (2 lamp) | | 300 series (3 lamp) | | 400 series (4 lamp) | |
| | Viewing area* | Length | Height | Model | Shipping wgt (lb) | Model | Shipping wgt (lb) | Model | Shipping wgt (lb) |
| **1 panel 14 in x 17 in** | 14 x 17 | 14 | 21 | 77-201TS | 24 | 77-301TS | 24 | 77-401TS | 24 |
| **2 panel side by side** | 28 x 17 | 28 | 21 | 77-202TS | 44 | 77-302TS | 44 | 77-402TS | 44 |
| **3 panel side by side** | 42 x 17 | 42 | 21 | 77-203TS | 64 | 77-303TS | 64 | 77-403TS | 64 |
| **4 panel side by side** | 56 x 17 | 56 | 21 | 77-204TS | 64 | 77-304TS | 64 | 77-404TS | 64 |
| **5 panel side by side** | 70 x 17 | 70 | 21 | 77-205TS | 107 | 77-305TS | 107 | 77-405TS | 107 |
| **6 panel side by side** | 84 x 17 | 84 | 21 | 77-206TS | 125 | 77-306TS | 125 | 77-406TS | 125 |
| **1 over 1, 14 in x 17 in** | 2 x 14 x 17 | 14 | 42 | 77-211TS | 37 | 77-311TS | 37 | 77-411TS | 37 |
| **2 over 2** | 2 x 28 x 17 | 28 | 42 | 77-222TS | 82 | 77-322TS | 82 | 77-422TS | 82 |
| **3 over 3** | 2 x 42 x 17 | 42 | 42 | 77-233TS | 125 | 77-333TS | 125 | 77-433TS | 125 |
| **4 over 4** | 2 x 56 x 17 | 56 | 42 | 77-244TS | 158 | 77-344TS | 158 | 77-444TS | 158 |
| **5 over 5** | 2 x 70 x 17 | 70 | 42 | 77-255TS | 307 (crated) | 77-355TS | 307 (crated) | 77-455TS | 307 (crated) |
| **6 over 6** | 2 x 84 x 17 | 84 | 42 | 77-266TS | 346 (crated) | 77-366TS | 346 (crated) | 77-466TS | 346 (crated) |

*Viewing height is actually 16.5 inches in order that extraneous light is eliminated when standard 14 in x 17 in film is inserted in the roller gravity grip.

# 77-201TR to 77-406TS

## MAXANT TECHLINE Illuminators

FLUKE® Biomedical

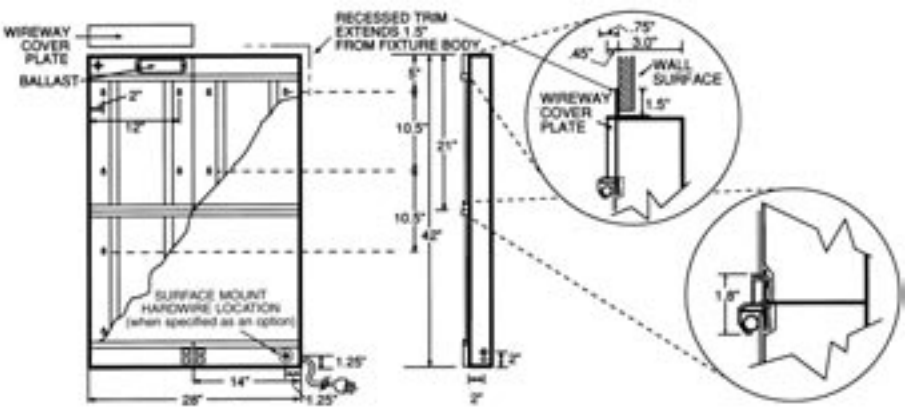
## Specifications

| Recess mounted | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Dimensions (inches) | | | 200 series (2 lamp) | | 300 series (3 lamp) | | 400 series (4 lamp) | |
| | Viewing area* | Wall cutout** | | Model | Shipping wgt (lb) | Model | Shipping wgt (lb) | Model | Shipping wgt (lb) |
| | | Length | Height | | | | | | |
| 1 panel 14 in x 17 in | 14 x 17 | 14.75 | 21.75 | 77-201TS | 26 | 77-301TS | 26 | 77-401TS | 26 |
| 2 panel side by side | 28 x 17 | 28.75 | 21.75 | 77-202TS | 45 | 77-302TS | 45 | 77-402TS | 45 |
| 3 panel side by side | 42 x 17 | 42.75 | 21.75 | 77-203TS | 64 | 77-303TS | 64 | 77-403TS | 64 |
| 4 panel side by side | 56 x 17 | 56.75 | 21.75 | 77-204TS | 87 | 77-304TS | 87 | 77-404TS | 87 |
| 5 panel side by side | 70 x 17 | 70.75 | 21.75 | 77-205TS | 107 | 77-305TS | 107 | 77-405TS | 107 |
| 6 panel side by side | 84 x 17 | 84.75 | 21.75 | 77-206TS | 128 | 77-306TS | 128 | 77-406TS | 128 |
| 1 over 1, 14 in x 17 in | 2 x 14 x 17 | 14.75 | 42.75 | 77-211TS | 39 | 77-311TS | 39 | 77-411TS | 39 |
| 2 over 2 | 2 x 28 x 17 | 28.75 | 42.75 | 77-222TS | 86 | 77-322TS | 86 | 77-422TS | 86 |
| 3 over 3 | 2 x 42 x 17 | 42.75 | 42.75 | 77-233TS | 126 | 77-333TS | 126 | 77-433TS | 126 |
| 4 over 4 | 2 x 56 x 17 | 56.75 | 42.75 | 77-244TS | 165 | 77-344TS | 165 | 77-444TS | 165 |
| 5 over 5 | 2 x 70 x 17 | 70.75 | 42.75 | 77-255TS | 328 (crated) | 77-355TS | 328 (crated) | 77-455TS | 328 (crated) |
| 6 over 6 | 2 x 84 x 17 | 84.75 | 42.75 | 77-266TS | 364 (crated) | 77-366TS | 364 (crated) | 77-466TS | 364 (crated) |

*Viewing height is actually 16.5 inches in order that extraneous light is eliminated when standard 14 in x 17 in film is inserted in the roller gravity grip.

**Overall recessed fixture dimensions, including recessed trim length and height, are each 3 inches greater than surface mounted dimensions.

| Replacement parts | |
|---|---|
| **77-FAMS** | Film Activated Micro Switch |
| **77-CS-REPL** | Cluster Switching |
| **77-MS-REPL** | ON/OFF Master Switch |
| **77-LC-REPL** | Line Cord and Plug Assembly |
| **77-REPL-VP** | Translucent Viewing Panel (per panel) |
| **77-HGP-REPL** | Hospital Grade Plug |
| **77-BAL-200** | Ballasts Techline 200 Series |
| **77-BAL-300S** | Ballasts Techline 300 Series single intensity |
| **77-BAL-300D** | Ballasts Techline 300 Series dual brightness |
| **77-BAL-400S** | Ballasts Techline 400 Series single intensity |
| **77-BAL-400D** | Ballasts Techline 400 Series dual brightness |
| **Re-mount retrofit kits** | |
| **77-REC/SUR** | Recess to Surface (per panel) |
| **77-SUR/REC** | Surface to Recess (per panel) |


WIREWAY COVER PLATE
BALLAST
RECESSED TRIM EXTENDS 1.5" FROM FIXTURE BODY
WALL SURFACE
WIREWAY COVER PLATE
SURFACE MOUNT HARDWIRE LOCATION (when specified as an option)

Film Handling and Storage

### Optional accessories

**77-FAS** Film Activated Switch
**77-MS** On/Off Master Switch
**77-DB300** Hi/Low Dual Brightness Switch 300 series (includes FAS)
**77-DB400** Hi/Low Dual Brightness Switch 400 series (includes FAS)
**77-HGP** Hospital Grade Plug
**77-HW** Surface Mount/Hard Wired
**77-HF** Handle and Non-Skid Feet

**Diagnostic Viewing Center (per system)**
**77-DVC11** to **77-DVC44**
**77-DVC55** and **77-DVC66**
**77-DVC90** (with Bright Spot capability)
**77-DVC91** (without Bright Spot capability)
**77-DVC11C** (1 over 1 Angulated Corner System)
**77-DVC00** (1 over 1 Vertical Corner System) (available in one and two panel configurations only)

# 77-201TR to 77-406TS

## MAXANT TECHLINE Illuminators

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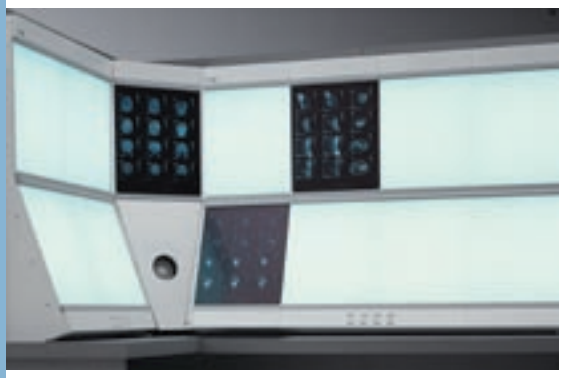


**Diagnostic Viewing Center (DVC)**

The features and benefits of the Techline can be combined with Maxant's family of Diagnostic Viewing Center angled and corner mounting systems for maximum viewing flexibility.

The DVC angulation system creates a two tier fixture with a vertical top tier and a bottom tier angled at 20°. A Techline illuminator housed in a DVC angulations system maintains all of the standard features associated with the Techline, including centralized cluster switching, minimal 1.8 inch separation between tiers, roller gravity grip, etc. The DVC angulation system provides an optimal viewing environment for easy top to bottom image construction.

Techline illuminators may also be positioned in a DVC Corner System. The DVC Corner System combined with the DVC Angulation System provides effective use of awkward corner space. DVC corner systems allow for a single viewing panel in the top tier of the corner system and a choice for the bottom section of either: a) a painted lower panel to cover the open area; or, b) a lower panel with a bright spot capability (as shown above, bright, spot NOT included).

All DVC products may be wall or counter top mounted.

**High Intensity Hot Lamp**

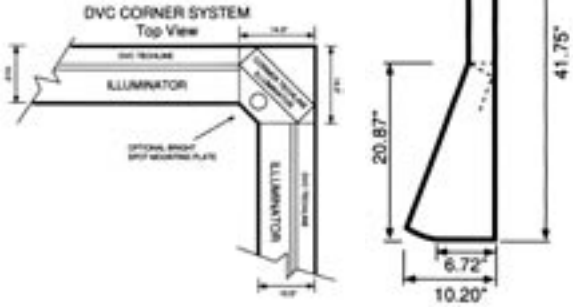
- For bright spot/hot light film illuminator
- Variable rheostat foot switch turns lamp on or off and varies intensity

The MAXANT Hot Lamp allows for intense illumination of excessively dark areas on films. It's construction is steel with a powder coat light gray finish. It comes with a 7 ft switch cord and can be table or wall mounted.

## Specifications

| Diagnostic Viewing Center (DVC) | | |
|---|---|---|
| **77-DVC11** | 1 over 1 angled | 14.25 in x 41.75 in |
| **77-DVC22** | 2 over 2 angled | 28.25 in x 41.75 in |
| **77-DVC33** | 3 over 3 angled | 42.25 in x 41.75 in |
| **77-DVC44** | 4 over 4 angled | 56.25 in x 41.75 in |
| **77-DVC55** | 5 over 5 angled | 70.25 in x 41.75 in |
| **77-DVC66** | 6 over 6 angled | 84.25 in x 41.75 in |

| DVC Corner System | |
|---|---|
| **77-DVC90** | Corner kit with bright spot capability (bright spot not included) |
| **77-DVC91** | Corner kit without bright spot capability |




### Optional accessories

**77-101HL** High Intensity Hot Lamp

### Ordering information

All DVC angulation systems and corner systems must be specified at the time an order is placed. Not All DVC systems are retrofitable to existing fixtures.

Other DVC angles may be available upon request.

# 77-201VR to 77-266VS

## MAXANT MVP Illuminators

Available in configurations from a single 14 in x 17 in panel up to a six over six, the MAXANT MVP Illuminator is a two lamp light source that emits approximately 2000 NITS of luminescence designed to provide a reliable solution to most viewing needs. The FLEXI-GRIP Film Holding System handles all film thicknesses, wet or dry and requires no field adjustment. The high gloss finish is standard hospital white compatible with most medical facility decors. The shatterproof translucent viewing panel provides consistently even light diffusion and is easily removed for cleaning and maintenance. And the bottom film ledge allows for reading of multiple film sizes on a viewing area. This illuminator is the reliable light source for the value-minded customer.

**Applications**

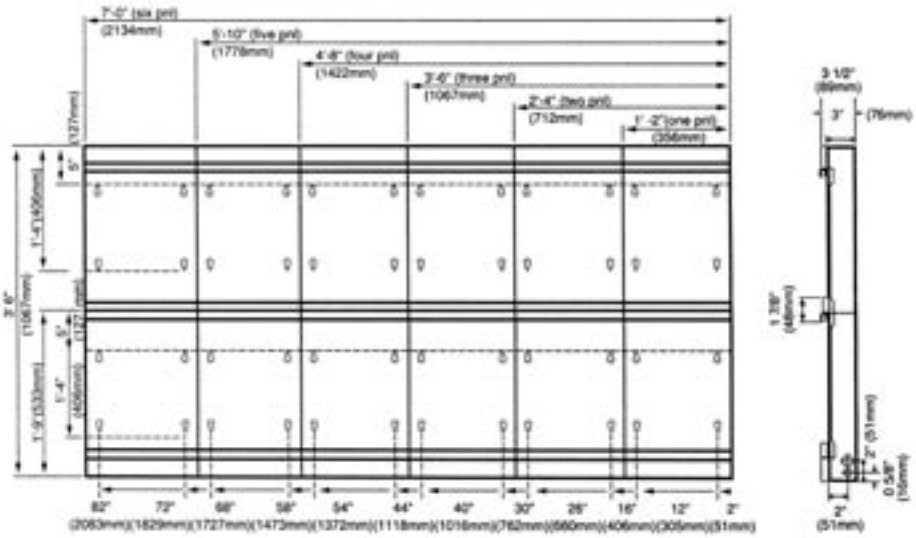
The Maxant MVP Illuminators are ideal for use in clinics and private office settings. Rugged and durable, MVP Illuminators combine quality and affordability in one diagnostic viewer.

### Key features

- Thin 3.375 inch profile
- Sturdy steel construction
- FLEXI-GRIP, handles all film thicknesses, wet or dry
- Continuous bottom film ledge
- Minimal 1.8 inch separation between tiers of two tiered fixtures
- Shatterproof translucent panel provides consistently even light diffusion
- Engineered design easily serviced
- Baked white enamel finish
- UL listed and CSA approved
- Centralized cluster switching (optional)
- Film activated micro switch (optional)
- Multi-panel master switch (optional)
- Surface mount hardwire (optional)
- Hospital-grade plug (optional)

## Specifications

| |
|---|
| Each viewing area has a 110 V power supply. Each viewing area contains two 15 W daylight fluorescent lamps which are controlled by two ballast |
| Safety rating: All ballasts are UL listed and C.S.A. approved |
| Each MVP viewing panel 110 V to 124 V, 60 Hz, 0.7 A per panel |
| Two lamps: #F15T8/D or equivalent |
| Ground chassis with 3 wire, 6 ft cord and NEMA 5-15, 2 pole, 3 wire ground plug |
| No hazardous electrical parts are exposed when the diffusing panel is removed for cleaning or lamp replacement |



# 77-201VR to 77-266VS

## MAXANT MVP Illuminators

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## Specifications

| Surface mounted | | | | | | |
|---|---|---|---|---|---|---|
| | Dimensions (inches) | | | Model | Model with FAS option*** | Shipping wgt (lb) |
| | Viewing area* | Length | Height | | | |
| **1 panel 14 in x 17 in** | 14 x 17 | 14 | 21 | 77-201VS | 77-201VS-FAS | 17 |
| **2 panel side by side** | 28 x 17 | 28 | 21 | 77-202VS | 77-202VS-FAS | 33 |
| **3 panel side by side** | 42 x 17 | 42 | 21 | 77-203VS | 77-203VS-FAS | 50 |
| **4 panel side by side** | 56 x 17 | 56 | 21 | 77-204VS | 77-204VS-FAS | 67 |
| **5 panel side by side** | 70 x 17 | 70 | 21 | 77-205VS | 77-205VS-FAS | 84 |
| **6 panel side by side** | 84 x 17 | 84 | 21 | 77-206VS | 77-206VS-FAS | 101 |
| **1 over 1, 14 in x 17 in** | 2 x 14 x 17 | 14 | 42 | 77-211VS | 77-211VS-FAS | 33 |
| **2 over 2** | 2 x 28 x 17 | 28 | 42 | 77-222VS | 77-222VS-FAS | 67 |
| **3 over 3** | 2 x 42 x 17 | 42 | 42 | 77-233VS | 77-233VS-FAS | 101 |
| **4 over 4** | 2 x 56 x 17 | 56 | 42 | 77-244VS | 77-244VS-FAS | 134 |
| **5 over 5** | 2 x 70 x 17 | 70 | 42 | 77-255VS | 77-255VS-FAS | 278 (crated) |
| **6 over 6** | 2 x 84 x 17 | 84 | 42 | 77-266VS | 77-266VS-FAS | 346 (crated) |

*Viewing height is actually 16.5 inches in order that extraneous light is eliminated when standard 14 in x 17 in film is inserted.

***Film Activated Switches (FAS) options.

| Recess mounted | | | | | | |
|---|---|---|---|---|---|---|
| | Dimensions (inches) | | | Model | Model with FAS option*** | Shipping wgt (lb) |
| | Viewing area* | Wall cutout** | | | | |
| | | Length | Height | | | |
| **1 panel 14 in x 17 in** | 14 x 17 | 14.75 | 21.75 | 77-201VR | 77-201VR-FAS | 24 |
| **2 panel side by side** | 28 x 17 | 28.75 | 21.75 | 77-202VR | 77-202VR-FAS | 48 |
| **3 panel side by side** | 42 x 17 | 42.75 | 21.75 | 77-203VR | 77-203VR-FAS | 72 |
| **4 panel side by side** | 56 x 17 | 56.75 | 21.75 | 77-204VR | 77-204VR-FAS | 96 |
| **5 panel side by side** | 70 x 17 | 70.75 | 21.75 | 77-205VR | 77-205VR-FAS | 120 |
| **6 panel side by side** | 84 x 17 | 84.75 | 21.75 | 77-206VR | 77-206VR-FAS | 144 |
| **1 over 1, 14 in x 17 in** | 2 x 14 x 17 | 14.75 | 42.75 | 77-211VR | 77-211VR-FAS | 48 |
| **2 over 2** | 2 x 28 x 17 | 28.75 | 42.75 | 77-222VR | 77-222VR-FAS | 96 |
| **3 over 3** | 2 x 42 x 17 | 42.75 | 42.75 | 77-233VR | 77-233VR-FAS | 144 |
| **4 over 4** | 2 x 56 x 17 | 56.75 | 42.75 | 77-244VR | 77-244VR-FAS | 192 |
| **5 over 5** | 2 x 70 x 17 | 70.75 | 42.75 | 77-255VR | 77-255VR-FAS | 320 (crated) |
| **6 over 6** | 2 x 84 x 17 | 84.75 | 42.75 | 77-266VR | 77-266VR-FAS | 368 (crated) |

*Viewing height is actually 16.5 inches in order that extraneous light is eliminated when standard 14 in x 17 in film is inserted.

**Overall recessed fixture dimensions, including recessed trim length and height, are each three inches greater than surface mounted dimensions.

***Film Activated Switches (FAS) options.

| Replacement parts | |
|---|---|
| **77-MS-REPL** | On/Off Master Switch |
| **77-CS-REPL** | Cluster Switching |
| **77-BAL-REPL** | Ballast |
| **77-STARTER** | Starter |
| **77-HGP-REPL** | Hospital Grade Plug |
| **77-DP-REPL** | Diffusion Panel (per panel) |
| **77-LC-REPL** | Line Cord and Plug Assembly |
| **Re-mount retrofit kits** | |
| **77-REC/SUR** | Recess to Surface (per panel) |
| **77-SUR/REC** | Surface to Recess (per panel) |

### Optional accessories

**77-CS** Cluster Switching
**77-MS** On/Off Master Switch
**77-HGP** Hospital Grade Plug
**77-HW** Surface Mount/Hard Wired
**77-HF** Handle and Non-Skid Feet

# 18-231-2350

## Fixer Retention QC Test Kit for Radiographic Film

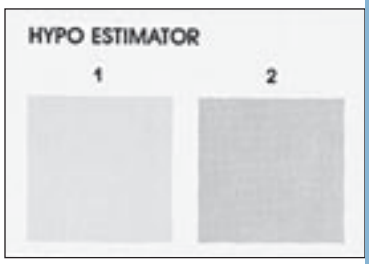
Too much residual fixer in processed film will have a degrading effect on the x-ray image. Over a period of time, the radiograph will start to turn brown and deteriorate, rendering it useless to the physician.

The 18-231-2350 Fixer Retention Test Kit allows you to routinely monitor your film processor's washing capabilities. By applying the kit's solution to a test film and comparing the resulting stain to the comparison strip, you can quickly determine if insufficient washing has left a large amount of residual fixer on the film. This simple chemical test will show you whether the film is stable, or whether corrective action is needed to protect the long life of your radiographs.

The bottle of test chemical makes 100 ml of solution, enough to provide dozens of tests.

### Key features

- Helps ensure the image quality of stored radiographs
- Determines the amount of residual fixer in processed film
- Helps eliminate degradation of image stability
- Allows you to take immediate corrective action




## Specifications

| | |
|---|---|
| **Weight of kit** | 0.12 kg (0.25 lb) |

### Included accessories

**18-231** Fixer Retention Test Chemical Solution

**18-235** Hypo-Estimator Comparison Strip

### Ordering information

**18-231-2350** Fixer Retention Test Kit

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# 18-220

## Mammographic Accreditation Phantom

The 18-220 Mammographic Accreditation Phantom will assist you in complying with MQSA and the American College of Radiology (ACR) Quality Control Programs. This phantom is intended for use as an integral part of the Mammographic Quality Control Program, and when used to perform routine mammographic QC, it will help you quickly, easily, and accurately evaluate the overall imaging performance of your mammographic system. This phantom will detect imaging changes so you can make the necessary corrections in order to maintain your system at peak performance.

The 18-220 Mammographic Accreditation Phantom was designed to test the performance of a mammographic system by a quantitative evaluation of the system's ability to image small structures similar to those found clinically. Objects within the phantom simulate calcifications, fibrous calcifications in ducts, and tumor masses.

The phantom is also designed to determine if a mammographic system can detect small structures that are important in the early detection of breast cancer. Test objects within the phantom range in size from those that should be visible on any system, to objects that will be difficult to see even on the best mammographic system.

### Key features

- Helps ensure optimum image quality and peak performance of the mammographic system
- Essential for MQSA compliance
- Complies with ACR phantom specifications and QC requirements
- Contains test objects to simulate indications of breast cancer; punctuate calcifications, tissue fibrillar extensions in adipose tissue, and tumor like masses
- Ideal for monitoring the overall performance of your mammographic imaging system, x-ray generator, film processor, and screen-film combination
- Equivalent in x-ray attenuation to a 4.5 cm compressed "average" breast

Optional are two 2 cm acrylic plates. The addition of these two plates, when combined with the overall 4.4 cm thickness of the phantom, will allow the system image quality to be checked in varying thicknesses of 2 cm to 8.5 cm. Both of these items are recommended by ACR in their Mammography Quality Control Procedure.

## Specifications

| **Phantom body** | | |
|---|---|---|
| **Material** | Acrylic | |
| **Dimensions** | Overall (WxDxH): 10.15 cm x 10.8 cm x 4.4 cm (4 in x 4.25 in x 1.75 in) | |
| | Acrylic base: 3.4 cm in thick (1.375 in) | |
| | Cover: 3 mm thick (0.128 in) | |
| | Acrylic contrast test disk: 1 cm Ø x 4 mm | |
| **Weight** | 0.55 kg (1.2 lb) | |
| **Wax insert** | | |
| **Nylon fibers** | **Al2O3 Specks** | **Masses (thickness)** |
| 1) 1.56 mm | 7) 0.54 mm | 12) 2 mm |
| 2) 1.12 mm | 8) 0.4 mm | 13) 1 mm |
| 3) 0.89 mm | 9) 0.32 mm | 14) 0.75 mm |
| 4) 0.75 mm | 10) 0.24 mm | 15) 0.5 mm |
| 5) 0.54 mm | 11) 0.16 mm | |
| 6) 0.4 mm | | |

### Optional accessories

**18-237** Acrylic Plates, 10 cm x 10 cm x 2 cm thick, set of 2
**18-205** Acrylic Contrast Test Disc, 1 cm Ø x 4 mm
**89-220** Carrying Case

### Included accessories

Acrylic contrast test disk, faxitron x-ray image, and magnifying glass

### Ordering information

**18-220** Mammographic Accreditation Phantom

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# 18-250

## Digital Stereotactic Breast Biopsy Accreditation Phantom*

Phantom with image evaluation insert

In the past, there was not an easy way to compare the image quality of conventional and digital biopsy mammography units because the field of view on the digital system is typically much smaller than the 24 cm x 30 cm field of view on conventional mammography units. In order to image the Mammographic Accreditation Phantom specified by the American College of Radiology (ACR) on the biopsy units, the user has to move the phantom to various positions in order to obtain four separate images, to be sure all objects were imaged. This is a very inconvenient, time consuming task.

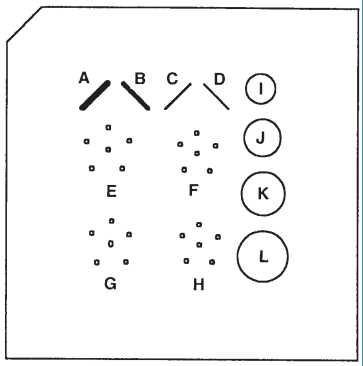
The small size of the 18–250 Digital Stereotactic Breast Biopsy Accreditation Phantom phantom permits fast, easy comparison of conventional and digital image quality, because you can attain an image of the entire unit in a single exposure. The objects are some of the same ones found in the Mammographic Accreditation Phantom specified by the ACR, so it makes comparison of the two imaging systems easy.

### Key features

- The fast, easy way to test image quality on digital biopsy mammography units and qualify for ACR accreditation
- Accepted by the ACR for use in its Stereotactic Breast Biopsy Accreditation Program
- One exposure is all you need
- The phantom contains test objects that are similar to those found in the Mammographic Accreditation Phantom specified by the ACR
- The extended top edge of the phantom allows ease of positioning on recumbent biopsy units
- The phantom's small size allows it to be imaged in its entirety in a single exposure when used with a digital biopsy unit
- Enables you to determine if the images are similar to or better than screen-film

## Specifications

| **Phantom body** | | |
|---|---|---|
| **Material** | Cast acrylic base block | |
| **Dimensions** (WxDxH) | 6.05 cm x 6.2 cm x 3.71 cm (2.38 in x 2.44 in x 1.46 in) | |
| **Weight** | 1.2 kg (8.7 oz) | |
| **Wax insert** | | |
| **Fibers** | **Al2O3 Specks** | **Masses** |
| A) 0.93 mm nylon fiber | E) 0.54 mm speck | I) 0.25 mm (thickness) mass |
| B) 0.74 mm nylon fiber | F) 0.32 mm speck | J) 0.5 mm (thickness) mass |
| C) 0.54 mm nylon fiber | G) 0.24 mm speck | K) 0.75 mm (thickness) mass |
| D) 0.32 mm nylon fiber | H) 0.2 mm speck | L) 1 mm (thickness) mass |




Digital image demonstrating image evaluation insert

### Ordering information

**18-250** Digital Stereotactic Breast Biopsy Accreditation Phantom

*Designed by Carol Mount, R.T. (R) (M), and Joel E. Gray, Ph.D., Department of Diagnostic Radiology, Mayo Clinic®, Rochester, MN 55905. Manufactured under licensing agreement with Mayo Foundation for Medical Education and Research.

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# 18-251-2000

## Contrast and Resolution Mammography Phantom*

The 18-251-2000 Contrast and Resolution Mammography Phantom is designed with an extended top edge to aid the user in positioning it on recumbent biopsy tables.

On digital mammography units, this phantom can test the high contrast spatial resolution of the system with the results being viewed on the monitor. The focal spot high contrast resolution can also be determined by placing a conventional mammography cassette behind the phantom and making an appropriate exposure.

It is suggested that a resolution test pattern from 5-20 LP/mm be used to evaluate the condition of the focal spot. Instead of making focal spot measurements that can be ambiguous, an accurate determination of the x-ray tube's resolution ability can be measured by using the optional Resolution Test Pattern (07-555).

On conventional mammography units, the phantom can be used to meet the ACR guidelines for testing focal spot resolution. The ACR suggests placing a resolution target 4.5 cm above the image receptor and imaging twice: once parallel to the anode-cathode axis and once rotated 90 degrees. With two resolution targets, this can be achieved in a single exposure. The grey scale step wedge can also be used to check the dynamic range of the entire system, indicate processing problems, and variation in film emulsion.

### Key features

**With a single exposure you can:**

- Measure the contrast and dynamic range of the imaging system
- Easily measure the system resolution of the focal spot length and width on mammography units (with optional Resolution Test Pattern, 07-555)

Phantom with two 5-20 LP/mm test patterns (optional) in parallel and perpendicular orientation. Also includes an air step wedge with aluminum attenuator.

## Specifications

| | |
|---|---|
| **Phantom body** | |
| **Materials** | Cast acrylic block with aluminum plate |
| **Dimensions** (WxDxT) | 6.66 cm x 6.4 cm x 4.3 cm (2.6 in x 2.5 in x 1.7 in) |
| **Weight without test patterns** | 8 oz (0.5 lb) |
| **07-555 Optional Resolution Test Pattern** | |
| **Material** | Gold nickel construction (equivalent to 25 microns of lead or 2.6 mm of aluminum) |
| **Dimensions** (LxW) | 25 mm x 12.5 mm |
| **Thickness** | 0.0175 mm (0.0152 mm gold, 0.0025 mm nickel) |

### Optional accessories

**07-555** Resolution Test Pattern

### Ordering information

**18-251** Contrast and Resolution Mammography Phantom

**18-251-1000** Contrast and Resolution Mammography Phantom with one resolution test pattern (07-555)

**18-251-2000** Contrast and Resolution Mammography Phantom with two resolution test patterns (07-555)

*Designed by Carol Mount, R.T. (R) (M), and Joel E. Gray, Ph.D., Department of Diagnostic Radiology, Mayo Clinic®, Rochester, MN 55905. Manufactured under licensing agreement with Mayo Foundation for Medical Education and Research.

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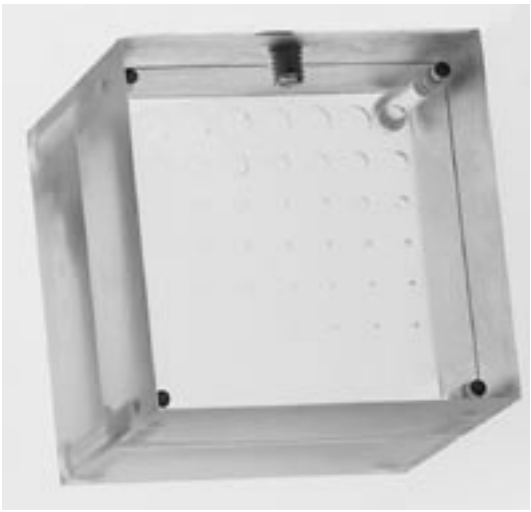
# 18-252

## Contrast Detail Phantom for Mammography



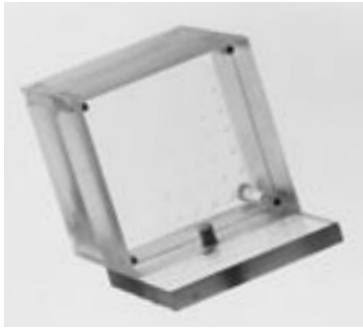
The 18-252 Contrast Detail Phantom for Mammography is designed to provide a means of quantitatively testing and monitoring the total performance of an entire mammographic imaging chain. Its small size, as well as the number and distribution of holes simulating embedded objects, make this phantom particularly useful in evaluating digital spot mammography systems. With 49 holes generating subtle contrast variations, the phantom makes it possible to detect small changes in overall system performance.

The Contrast Detail Phantom for Mammography contains a 7 x 7 matrix of objects. The diameter of each row of objects decreases from 0.169 inch to 0.007 inch. In each row, the subject contrast decreases from approximately 6.6 % to 0.41 % at mammographic energies.

The Contrast Detail Phantom for Mammography is easy to use. Simply place the phantom on the image receptor surface in the same position as a breast. Position the x-ray tube and compression device as in a craniocaudal examination. When using the phantom on prone-position breast biopsy systems, use the rotating top plate of the phantom and the compression device to secure the phantom against the image receptor. Choose the appropriate kV and mAs factors (26 kV and 60 mAs works well on most systems), or select automatic exposure control.

### Key features

- Optimized for digital imaging
- Easy-to-use, compact and lightweight
- Closely simulates scattering conditions of the breast
- Rotatable support plate accommodates prone-position x-ray units. The plate can be returned to a position that does not interfere with placement of the phantom on flat surfaces
- Geometrically-increasing hole depths result in linearly-increasing x-ray transmission
- Geometrically-increasing hole diameters enable quantitative measurement of the contrast threshold of the mammographic system



Rotatable support plate accommodates prone-position x-ray units

## Specifications

| | | |
|---|---|---|
| **Phantom material** | Plexiglas® | |
| **Dimensions** (WxDxH) | 6.27 cm x 6.27 cm x 6.27 cm (2.47 in x 2.47 in x 2.47 in) | |
| **Weight** | 0.58 kg (1.2 lb) | |
| **Object diameter and contrast** | | |
| **Column number** | **Object depth** | **Typical contrast at mammographic energies** |
| **1** | 0.853 mm (0.033 in) | 6.6 % |
| **2** | 0.533 mm (0.021 in) | 4.2 % |
| **3** | 0.332 mm (0.013 in) | 2.6 % |
| **4** | 0.208 mm (0.008 in) | 1.7 % |
| **5** | 0.129 mm (0.005 in) | 1 % |
| **6** | 0.08 mm (0.003 in) | 0.65 % |
| **7** | 0.05 mm (0.002 in) | 0.41 % |

| **Object diameter** | | | |
|---|---|---|---|
| **Row number** | **Object diameter** | **Row number** | **Object diameter** |
| **1** | 4.292 mm (0.169 in) | **5** | 0.513 mm (0.02 in) |
| **2** | 2.524 mm (0.099 in) | **6** | 0.302 mm (0.011 in) |
| **3** | 1.485 mm (0.058 in) | **7** | 0.177 mm (0.007 in) |
| **4** | 0.873 mm (0.034 in) | | |

| **Row number** | **Minimum number of objects detected** |
|---|---|
| 1 | 6 |
| 2 | 6 |
| 3 | 5 |
| 4 | 4 |
| 5 | 2 |
| 6 | 1 |
| 7 | 0 |
| Minimum detectability score: 24/49 | |

### Ordering information

**18-252** Contrast Detail Phantom for Mammography

FLUKE®
Biomedical

# 18-227

## CDMAM Phantom*

### Key features

- Helps identify objects with very low contrast and very small diameter
- Compatible with full-field analog and digital units
- Compares of image quality with various screen-film combinations
- Evaluates conventional, digital, and stereotactic modalities
- Determines the optimum exposure technique, e.g., by variation of tube potential
- Compares image quality at various object thicknesses, by variation of the amount of Plexiglas® at a fixed density

The 18-227 CDMAM (Contrast Detail Mammography) Phantom was developed to evaluate conventional mammographic x-ray equipment, film, and cassettes. However, with the increase of digital imaging in mammography, especially when performing stereotactic breast needle biopsies and preoperative needle localizations, the phantom can aid in achieving improved image quality, processing, display quality, and speed in these new modalities.

**What makes the CDMAM Phantom so special?**
The CDMAM Phantom consists of an aluminum base with gold discs (99.99 % pure gold) of varying thicknesses and diameters, which is attached to a Plexiglas® cover. The 5 mm thick Plexiglas cover (PMMA plate) has a 2 mm deep cavity that accommodates the aluminum base with gold discs. The assembly (PMMA and aluminum) has a Plexiglas-equivalent thickness of 10 mm, under standard mammography-exposure conditions.

The aluminum base is 0.05 mm thick Al 1050 (99.5 % pure aluminum). The base has been polished and anodized black. Precisely measured gold discs of varying thickness (range = 0.05 µm to 1.6 µm) and diameter (range = 0.1 µm to 3.2 µm) have been attached to the base by means of evaporization. Finally, the base has been airbrushed to protect the gold discs.

**The "Gold Standard" of Mammographic Phantoms**
The discs are arranged in 16 rows and 16 columns. Within a row, the disc diameter is constant, with logarithmically increasing diameter. The precision of the disc diameter and thickness makes the CDMAM Phantom an ideal tool for conducting contrast-detail and other image quality experiments.

*Developed by M.A.O. Thijssen, Ph.D., K.R. Bijkerk, MSc. and J.M. Lindeyer, BSc., Project: Quality Assurance in Mammography (QAMAM), Department of Diagnostic Radiology, University Hospital, St. Radboud, Nijmegen, The Netherlands.

# 18-227

## CDMAM Phantom

A line pattern has been engraved onto the Plexiglas cover and treated with paint containing aluminum. The x-ray image will show a number of squares ordered in 16 columns and 16 rows, with the disc diameter shown for each row, and the disc thickness for each column.

The 18-227 CDMAM Phantom includes a set of four Plexiglas plates, which are used for the simulation of different breast thicknesses. The plates are 10 mm thick and the same dimensions as the phantom. The plates are marked in one corner, for identification of the configuration of Plexiglas and phantom in an x-ray image. The phantom and Plexiglas plates match the standard mammography film size (18 cm x 24 cm).

Under standard mammography-exposure conditions (Mo-anode, 30 µm Mo-filtration, 28 kVp), the phantom has a Plexiglas-equivalent thickness of 10 mm.

The actual attenuation of the CDMAM Phantom depends on the configuration of the phantom and Plexiglas plates. The effective energy of the phantom plane will be higher when more Plexiglas is added to the top and bottom of the phantom.

**Application**

To make an x-ray image, the CDMAM Phantom should be positioned on the bucky with the smallest disc diameters at the thorax side, in combination with one or more Plexiglas plates. The markings on the Plexiglas plates should be aligned at the thorax side of the bucky. On digital stereotactic systems with smaller fields of view, specific portions of the phantom can easily be imaged as well.

The density of the image has to be checked after the film has been processed. In a series of CD images, all images should approximately have the same densities in a reference-position on the film.

## Specifications

| | |
|---|---|
| **Dimensions** (WxDxT) | Plexiglas plates: 162.5 mm x 240 mm x 10 mm (6.38 in x 9.45 in x 0.4 in) |
| | Aluminum base: 162.5 mm x 240 mm x 0.5 mm |
| **Weight** | 2.06 kg (4.54 lb) |

### Included accessories

Four Plexiglas plates

### Ordering information

**18-227** CDMAM Phantom

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# 18-222

## Tissue-Equivalent Mammography Phantom

Proven simulation technology enables the use of tissue-equivalent, realistically-shaped phantoms for mammographic quality control.

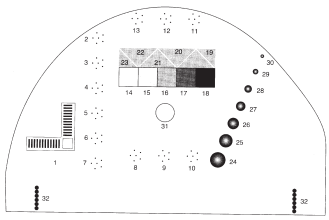
The 18-222 Tissue-Equivalent Mammography Phantom contains targets that are engineered to test the threshold of the new generation of mammography machines.

The phantom is 4.5 cm thick, simulates a 50 % glandular tissue composition and is designed to test the performance of a mammographic system by a quantitative evaluation of the system's ability to image small structures similar to those found clinically. The phantom is designed to determine if your system can detect small structures that are important in early detection of breast cancer. Test objects within the phantom range in size from those that should be visible on any system to objects that will be difficult to see in the best mammographic systems.

The 18-222 includes a 30x hand-held microscope and mammography QA documents for recording image evaluations and scores.

### Key features

- Breast phantom to test new generation of mammography machines
- A refined quality control for today's advanced imaging systems
- Objects within the phantom simulate calcifications, fibrous calcifications in ducts, and tumor masses



## Specifications

| | | | |
|---|---|---|---|
| **Line-pair target** | 1: 20 lp/mm | | |
| **Calcium carbonate specks** | 2: 0.13 | 3: 0.165 | 4: 0.196 |
| | 5: 0.23 | 6: 0.275 | 7: 0.4 |
| | 8: 0.23 | 9: 0.196 | 10: 0.165 |
| | 11: 0.23 | 12: 0.196 | 13: 0.165 |
| **Step wedge** (1 cm thick) | 14: 100 % gland | 15: 70 % gland | 16: 50 % gland |
| | 17: 30 % gland | 18: 100 % gland | |
| **Nylon fibers** | 19: 1.25 mm Ø | 20: 0.83 mm Ø | 21: 0.71 mm Ø |
| | 22: 0.53 mm Ø | 23: 0.3 mm Ø | |
| **Hemispheric masses** (75 % glandular/ 25 % adipose) | 24: 4.76 mm thick | 25: 3.16 mm thick | 26: 2.38 mm thick |
| | 27: 1.98 mm thick | 28: 1.59 mm thick | 29: 1.19 mm thick |
| | 30: 0.9 mm thick | | |
| **Optical density** | 31: reference zone | | |
| **Edge beam** | 32: localization target | | |
| **General** | | | |
| **Material** | Epoxy | | |
| **Dimensions** (WxDxH) | 18.5 cm x 12.5 cm x 4.5 cm (7.28 in x 4.92 in x 1.77 in) | | |
| **Weight** | 1 kg (2.2 lb) | | |

### Included accessories

**18-222**
Handheld microscope and mammography QA recording documents

**18-223**
Tissue-equivalent phantoms 4 cm, 5 cm, and 6 cm thick, and phototimer compensation plates from 0.5 cm to 7 cm

### Ordering information

**18-222** Tissue-Equivalent Mammography Phantom

**18-223** Mammography Phantom Research Set


**References**
Skubic S.E., Fatouros P.P., "Absorbed Breast Dose: Dependence on Radiographic Modality and Technique, and Breast Thickness," Radiology, 61 (1986), 263-270.
Fatouros P.P., Skubic S.E., Goodman H., "The Development and Use of Realistically Shaped, Tissue-Equivalent Phantoms for Assessing the Mammographic Process," Radiology, 32 (1985), 157.

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# 18-216

## Single-Exposure High Contrast Resolution Phantom

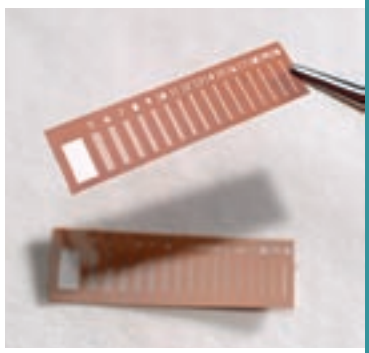
The 18-216 Single-Exposure High-Contrast Resolution Phantom incorporates a 17.5 micrometer-thick gold-nickel alloy bar pattern. This allows the assessment of resolution perpendicular and parallel to the anode-cathode axis in just one exposure. This pattern has segments from 5 lp to 20 lp/mm and is equivalent to 25 micrometers of lead, or 2.6 mm of aluminum at 20 keV. The bar pattern is permanently embedded in a thin acrylic wafer, to protect it from wear and damage.

The phantom body is available in BR-12 or BR50/50. It enables consistent, reproducible positioning of the bar pattern at 4.5 cm above the breast support plate at 1 cm from the chest wall, centered laterally as recommended by the American College of Radiology.

The bar pattern can also be positioned at a variety of heights for more thorough evaluations.

### Key features

- Perform quality control inspections of mammography system resolution with just one exposure
- Meets ACR guidelines
- Meets MQSA requirements
- Rugged, easy-to-use, and cost-effective
- The phantom includes a 30x handheld microscope.



## Specifications

| | |
|---|---|
| **Material** | BR12 or BR50/50 |
| **Dimensions** (WxDxH) | 100 mm x 125 mm x 20 mm |
| **Weight** | 0.57 kg (1.3 lb) |

### Optional accessories

**18-216-2555** Acrylic Wafer Test Pattern

### Included accessories

30x handheld microscope

### Ordering information

**18-216** Single-Exposure High Contrast Resolution Phantom, BR-12

**18-216-1000** Single-Exposure High Contrast Resolution Phantom, BR50/50

# 18-228 and 18-229-1313

## Stereotactic Biopsy Phantoms

18-228 Stereotactic Needle Biopsy Tissue-Equivalent Training Phantom

With the increasing use of stereotactic breast biopsy procedures, it is essential that radiology healthcare providers maintain and increase their needle biopsy skills. The 18-228 tissue-equivalent phantom is a MUST for every mammography facility.

The automated stereotactic breast biopsy procedure depends on several variables for accurate needle placement. Thus, for patient safety, this system must be properly maintained and evaluated.

This versatile 18-228 was designed to assist in training technologists and physicians in the use of a stereotactic system, and for verifying the proper operation of mammographic stereotactic biopsy systems.

Because the phantom closely mimics properties of the human breast, it is also an ideal teaching tool and practice medium for mammographic needle biopsy procedures. It should also be used whenever a new system is installed or repaired, to ensure accurate needle placement.

This training phantom is also an excellent research and development/demonstration tool for manufacturers of mammography equipment.

The phantom should be stored in a cool place. The phantom should be discarded after all the tumors have been aspirated.

### Key features

**18-228**

- Compressible
- Contains cysts, dense masses and calcifications
- Proprietary gel simulates physical density and mass attenuation of BR-12
- Gel will not dry out after initial needle punctures, thus extending storage life
- Physical consistency similar to human tissue, combined with an elastic, skin-like membrane, enables palpation of embedded structures and accurately simulates needle resistance
- Anthropomorphic shape allows for accurate simulation of breast compression

**18-229-1313**

- The most cost-effective and economical phantom for teaching, training, and QC

## Specifications

### 18-228

| Targets | Color | Dimensions | Quantity | Position |
|---|---|---|---|---|
| **Cystic masses** | green | 5 mm to 12 mm | 6 | Random |
| **Dense masses** | black | 5 mm to 12 mm | 6 | Random |
| **Microcalcifications** | orange | 0.3 mm to 0.35 mm | two clusters | Mid-plane on right and left sides |
| **General** | | | | |
| **Dimensions** (LxH) | 10 cm x 5 cm; 1500 cc | | | |
| **Weight** | 0.91 kg (2 lb) | | | |

### 18-229-1313 Mammo-Cube Stereotactic Core Biopsy Phantom

| | |
|---|---|
| **Embedded lesions** | Six dense masses, 5 to 12 mm Ø |
| **Proprietary gel** | Simulates the physical density and mass attenuation of BR-12. The gel will not dry out after initial needle punctures, thus extending storage life |
| **Physical consistency** | Similar to human tissue and combined with an elastic, skin-like membrane which enables palpation of embedded structures and accurately simulates needle resistance |
| **Care** | The phantom should be stored in a cool place, and discarded after all lesions have been biopsied |
| **Dimensions** (WxDxH) | 6.5 cm x 7 cm x 4.5 cm |
| **Weight** | 5 oz (Individual cube dimensions and weights may vary by 10 %) |

18-228 Mammo-Cube Stereotactic Core Biopsy Phantom

### Ordering information

**18-228** Stereotactic Needle Biopsy Tissue-Equivalent Training Phantom

**18-229-1313** Mammo-Cube Stereotactic Core Biopsy Phantom

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# 18-229

## Triple-Modality Biopsy Training Phantom

Suspect lesions discovered in x-ray mammography must often be evaluated under ultrasound to aid diagnosis and in some cases, use of MRI may be indicated. The 18-229 Triple-Modality Biopsy Training Phantom is an ideal training device because it can be imaged under three modalities and was designed specifically for needle biopsy.

The 18-229 Triple-Modality Biopsy Training Phantom is a disposable phantom that was designed to closely mimic the properties of the human breast, making it an extremely useful accessory for training technologists and physicians, as well as for verifying the proper operation of a mammographic biopsy system.

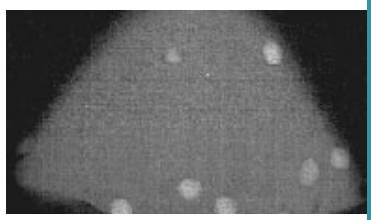
**Training**
With the increasing use of breast biopsy procedures, it is essential that radiology healthcare providers maintain and increase their needle biopsy skills. This training phantom is a must for every mammography facility.

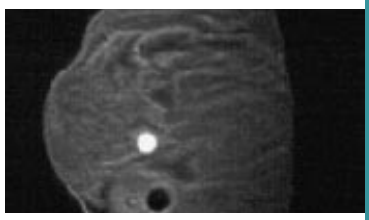
**Quality control**
The breast biopsy procedure depends on several variables for accurate needle placement. Thus, for patient safety, the system must be properly maintained and evaluated. A comprehensive mammography quality control program must provide assurances that all aspects of the mammography equipment are operating at optimum levels. The Triple-Modality Biopsy Training Phantom is the ideal tool for such a program. Additionally, the phantom can and should be used whenever a new system is installed or repaired, to ensure accurate needle placement.

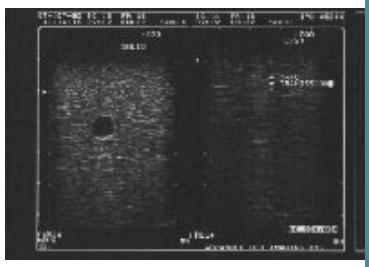
**Research and development**
This cost-effective phantom is also an excellent research and development/demonstration tool for manufacturers of mammography equipment.

### Key features

- Tissue-equivalent under x-ray, ultrasound, and MRI
- Compressible
- Ideal for physician and technologist training, and quality control
- Physical density and attenuation characteristics accurately simulate that of an average 50 % glandular breast (BR-12 equivalent)
- Flesh-like consistency allows for the palpation of embedded lesions while accurately simulating needle resistance found in human tissue
- Anthropomorphic shape is suitable for compression mammography, ultrasound or MRI examinations
- The American College of Radiology recommends this type of product in their quality assurance program


X-ray mammography


MRI


Ultrasound

## Specifications

| | |
|---|---|
| **Material** | Zerdine®[1] |
| **Targets** | Dense masses: 2 mm and 8 mm Ø for core biopsy |
| | Cystic masses: 3 mm to 10 mm Ø for needle aspiration |
| **Volume** | 500 cc |
| **Dimensions** (WxDxH) | 10 cm x 12 cm x 9 cm (3.94 in x 4.72 in x 3.54 in) |
| **Weight** | 0.44 kg (1 lb) |

[1]US Patent #5196343

### Ordering information

**18-229** Triple-Modality Biopsy Training Phantom

# 18-230 Series

## GRID-VIEW™ Breast Biopsy Transport and Imaging System*

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18-230-1000

The 18-230 Series GRID-VIEW System enables the breast biopsy procedure to be performed faster, easier and more accurately than ever before. With GRID-VIEW there is no longer an open, exposed specimen which must be handled a number of times. There is no longer a delay between the specimen being brought down from surgery to radiology to be placed on a makeshift imaging board. And with GRID-VIEW, there is no longer any guesswork as to the orientation of the specimen.

The GRID-VIEW System is composed of a sealable plastic container that contains a radiopaque grid which is lettered and numbered for accurate orientation. Once the top of the GRID-VIEW container is closed, the specimen is compressed onto the grid, making it stationary and ready for transport.

**Using GRID-VIEW makes your job easy**

1. Biopsy tissue is placed in the GRID-VIEW container.
2. GRID-VIEW container is delivered to radiology for image confirmation.
3. GRID-VIEW container with biopsy is delivered undisturbed to pathology with the x-ray image.
4. Specimen is compared with x-ray image by pathologist.

### Key features

- Reduces surgery time through improved imaging turnaround
- Improves communication between surgery, radiology and pathology
- Eliminates physical handling of specimen in radiology
- Reduces exposure to blood-borne pathogens
- Eliminates the need for needles or wires
- Meets all OSHA requirements for specimen handling

18-230-2000

18-230-3000

## Specifications

| | |
|---|---|
| **Weight** | 0.44 kg (1 lb) |

### Ordering information

**18-230-1000** GRID-VIEW System
**18-230-2000** GRID-VIEW System
**18-230-3000** GRID-VIEW System
Package of 12. Also, sold by the case (case contains 12 packages, or 144 units).

# 18-203 and 18-224

## Mammography Phototimer Consistency Test Tool and Mammography Phantom Material

18-203

### 18-203 Mammography Phototimer Consistency Test Tool

The mammographic unit's automatic exposure control should be capable of maintaining optical density within ± 0.15 OD as the voltage is varied from 25 kVp to 35 kVp, and as breast thickness is varied from 2 cm to 8 cm for each technique. Test images taken of uniform phantoms of varying thicknesses should not differ by more than 0.3 OD from each other. These tests should be carried out over the kVp range customarily used by the mammography center.

The 18-203 Phototimer Consistency Test Tool is available in two materials: acrylic; and, for more accurate results, breast-tissue-equivalent BR-12 material. Both are supplied in uniform 2 cm slabs to produce thicknesses of 2 mm, 4 mm, 6 mm, and 8 cm.

18-224

### 18-224 Mammography Phantom Material

The American College of Radiology's Committee on Quality Assurance in Mammography (Medical Physicist's Manual) recommends, as part of the required test equipment, the 18-224 Mammography Phantom Material. This material is best suited for testing automatic exposure control (AEC), collimator assessment, and artifact evaluation.

### Key features

**18-203**

- Available in either acrylic or tissue-equivalent BR-12 material*
- Should be used to test thickness tracking
- The American College of Radiology recommends this type of product in their quality assurance program
- Meets MQSA requirements

**18-224**

- Available in either acrylic or tissue-equivalent BR-12 material*

*BR-12 is a designation (D.R. White, et al.) of certain epoxy resin formulations which react to x-ray in the mammographic energy range (15 keV to 30 keV) in the same manner as human tissue. The tissue-simulation properties for these slabs are maximized at 20 keV (28 kVp ±). The glandular equivalency of this material is 45 % in the mammographic range.

## Specifications

| | |
|---|---|
| **18-203** | Material: Acrylic |
| | Dimensions (WxDxH): 10 cm x 12.5 cm x 2 cm thick |
| | Weight: 1.34 kg (3 lb) |
| **18-204** | Material: BR-12 |
| | Dimensions (WxDxH): 10 cm x 12.5 cm x 2 cm thick |
| | Weight: 1 kg (2.2 lb) |
| **18-238** | Material: BR-12 |
| | Dimensions (WxDxH): (3) 10 cm x 12.5 cm x 2 cm;<br>(2) 10 cm x 12.5 cm x 1 cm thick;<br>(1) 10 cm x 12.5 cm x 0.5 cm thick |
| | Weight: 1.2 kg (2.6 lb) |
| **18-238-3070** | Material: Tissue-equivalent, 30 % gland/70 % adipose |
| **18-238-5050** | Material: tissue-equivalent, 50 % gland/50 % adipose |
| **18-238-7030** | Material: tissue-equivalent, 70 % gland/30 % adipose |
| **18-224** | Material: Acrylic |
| | Dimensions (WxDxH): 10 cm x 12.5 cm x 2 cm thick |
| | Weight: 0.92 kg (2 lb) |
| **18-225** | Material: BR-12 |
| | Dimensions (WxDxH): (2) 18 cm x 24 cm x 2 cm thick |
| | Weight: 1.7 kg (3.8 lb) |

### Ordering information

**18-203** Mammography Phototimer Consistency Test Tool set of four acrylic slabs

**18-204** Mammography Phototimer Consistency Test Tool set of four BR-12 slabs

**18-238** Mammography Phototimer Consistency Test Tool Research, set of six BR-12 slabs

**18-238-3070** Mammography Phototimer Consistency Test Tool, set of six slabs

**18-238-5050** Mammography Phototimer Consistency Test Tool, set of six slabs,

**18-238-7030** Mammography Phototimer Consistency Test Tool, set of six slabs

**18-224** Mammographic Phantom Material

**18-225** Mammographic Phantom Material

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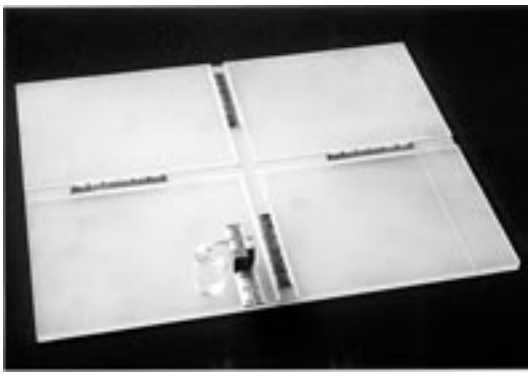
# 18-303

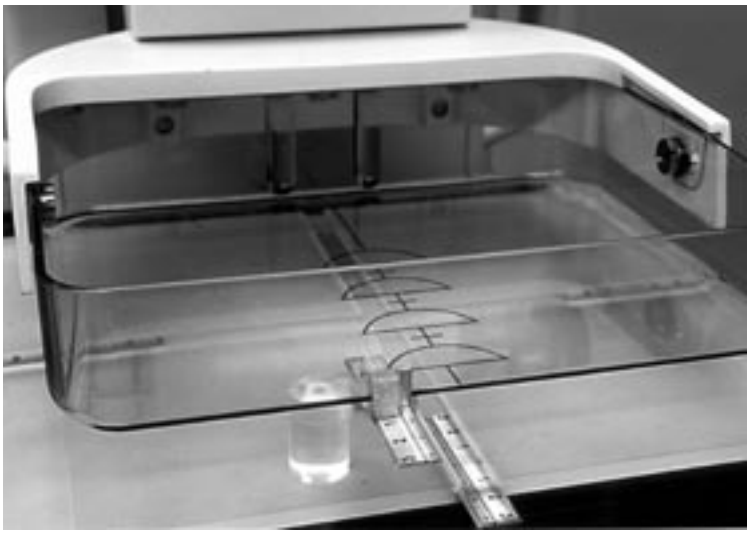
## Mammography Collimation Assessment Test Tool*



The 18-303 Mammography Collimation Assessment Test Tool is a self-contained precise QA tool that gives you instant measurements by simply viewing the image. The 18-303 Mammography Collimation Assessment Test Tool is simple to use. Just follow the exact instructions contained in the ACR Mammography QC Manual for the Collimation Assessment. However, instead of using all those hard-to-find coins, you use the 18-303. The "0" point of the metal ruler is placed at the edge of the light field. The compression paddle rests on top of the appropriate size plastic peg (1.7 mm and 2.2 cm pegs are included to accommodate different cassette thicknesses) and the alignment ruler (generously sized at 3 cm in both directions) fits snugly against the edge of the paddle. It couldn't be much simpler or much quicker.

### Key features

- Reduces setup time by half
- Simple to use
- Complies with MQSA testing requirements as contained in the ACR Mammography QC Manual
- Measurement can be quickly and easily repeated
- Compression paddle rests on peg exactly 4.2 cm above the bucky—no measurement of compression paddle height needed
- Stays firmly in place
- Adaptable for 18 cm x 24 cm, 24 cm x 30 cm and magnification stand testing



Mammography Collimation Assessment Test Tool shown in position

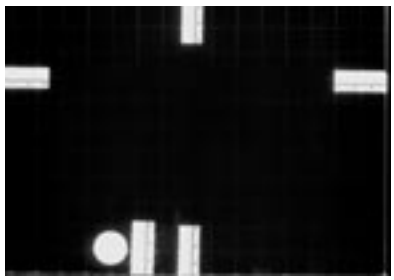


Image of test tool on top of bucky

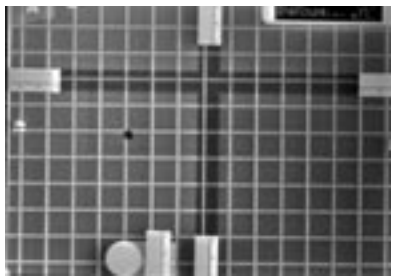


Image of test tool in bucky

## Specifications

| | |
|---|---|
| **Dimensions** (WxH) | 24 cm x 30 cm (9.45 in x 11.81 in) |
| **Weight** | 0.57 kg (1.25 lb) |

### Ordering information

**18-303** Mammography Collimation Assessment Test Tool, includes one 1.7 cm peg and one 2.2 cm peg

*Designed by Carol Mount, R.T. (R) (M), Supervisor of Mammography, Mayo Clinic®, Rochester, MN 55905. Manufactured under licensing agreement with Mayo Foundation for Medical Education and Research.

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# 18-210-8000

## View Markers for Mammography

As stated in the American College of Radiology Mammography Quality Control Manual, it is required that all mammography films are labeled to prevent misinterpretation. The 18-210-8000 View Markers provide the optimal solution to comply with ACR requirements.

The markers are radiopaque, and each is equipped with an attached "super hold" suction cup. Firm, gentle pressure will hold the suction cup in place on the side of the mammography unit.

### Key features

- Meets all requirements for standardized terminology set forth by the MQSA and American College of Radiology
- Standardized labeling of mammography films is essential to ensure that films are not misinterpreted

**Choose from the following kits:**

- Standard Kit (normal requirement) Consists of eight markers for the most frequently used positions. Weight is 0.24 kg (0.5 lb)
- Specialty Kit Consists of 14 specialty markers. Weight is 0.5 kg (1 lb).
- Full-Service Kit Consists of 22 markers (Standard Kit plus 14 specialty markers) for use with all possible positions. Weight is 0.78 kg (1.75 lb).

## Specifications

**Labeling codes for positioning***

| | Labeling code | Purpose |
|---|---|---|
| **Laterally** | | |
| **Right** | R** | |
| **Left** | L** | |
| **Projection position** | | |
| **Mediolateral oblique** | MLO | Standard view |
| **Craniocaudal** | CC | Standard view |
| **90° Lateral** | | |
| **Mediolateral** | ML | Localize, define |
| **Lateromedial** | LM | Localize, define |
| **Spot compression** | SPOT | Define |
| **Magnification** | M** | Define |
| **Exaggerated craniocaudal** | XCCL | Localize |
| **Cleavage** | CV | Localize |
| **Axillary tail** | AT | Localize, define |
| **Tangential** | TAN | Localize, define |
| **Rolled lateral** | RL (rolled lateral)† | Localize, define |
| **Rolled medial** | RM (rolled medial)† | Localize, define |
| **Caudocranial** | FB (from below) | Define |
| **Lateromedial oblique** | LMO | Define |
| **Superolateral to infermedial oblique** | SIO | Define |
| **Implant displaced** | ID | Augmented breast |

†Used as a suffix after the projection. For example, LCCRL equals Left Craniocaudal Upper Breast Tissue Rolled Laterally.
*Taken from ACR Mammography Quality Control Radiologic Technologist Manual.
**Used as a prefix before the projection. For example, RMMLO equals Right Magnification Mediolateral Oblique.

### Included accessories

Suction cup
Each set includes a holder (the small set gets a small holder, the larger sets get a larger holder).

### Ordering information

**18-210-8000** Standard Kit of 8 View Markers
**18-210-1400** Specialty Kit of 14 View Markers
**18-210-2200** Full-Service Kit of 22 View Markers

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# 76-410-4130

## AAPM CT Performance Phantom

The increasing use of computed tomography (CT) as a diagnostic tool creates the need for an efficient means of evaluating the performance of the CT scanners now in use. Recognizing this requirement, the American Association of Physicists in Medicine established the AAPM Task Force on CT Scanner Phantoms. Its goals are to define CT scanner performance and present practical methods of performance testing through the utilization of special phantoms. This phantom design is based on the guidelines presented in Report #1 of the Task Force and approved by the AAPM.

The modular 76-410-4130 AAPM CT Performance Phantom offers the CT user a single system with which to measure nine performance parameters. This phantom permits the routine standardization of alignment, beam width, spatial uniformity, linearity/contrast, spatial resolution, linespread, noise, size independence, and absorbed dose. All components of the phantom are housed in a compact, transparent tank that holds the system together in the correct orientation.

The phantom consists of an 8.5-inch diameter acrylic tank containing a beam-width insert, a spatial resolution and linespread block, a high-contrast insert, and a means for inserting alignment pins and/or TLD holders. Additionally, a 0.25-inch thick Teflon® band, positioned at the base of the tank and concentric to the 8-inch internal diameter, simulates human bone. Attached to the base of the tank is a low-contrast section with resealable cavities (from 1 in to 0.125 in diameter) which can be filled with a diluted dextrose or other appropriate solution to provide a low-contrast media. The optional external resolution and noise ring slides snugly over the outside diameter of the tank, allowing whole-body scanner systems to be evaluated.

### Key features

- Meets guidelines in AAPM Report No. 1 for Performance Evaluation and QC of CT Scanners
- Single system measures nine performance parameters

**This ONE phantom evaluates:**

- Noise
- Spatial resolution
- Sensitivity (low contrast resolution)
- Absorbed dose
- Size dependence
- Contrast scale
- Slice thickness
- Alignment
- Linearity
- Beamwidth

## Specifications

| | |
|---|---|
| **Watertank** | |
| **Material** | Made of acrylic |
| **Dimensions** (ODxIDxL) | (8.5 in x 8 in x 12.75 in) |
| Resealable with fill and drain ports. Low-contrast detectability block is attached to base | |
| **Linearity and contrast insert** | |
| **Dimensions** (ODxL) | (7.5 in x 2.5 in) |
| Contains 1 inch diameter contrast pins of polyethylene, acrylic, polycarbonate, polystyrene and nylon. Density values: polyethylene, 0.95 gm/cc; polystyrene, 1.05 gm/cc; nylon, 1.1 gm/cc; acrylic, 1.19 gm/cc; polycarbonate, 1.2 gm/cc | |
| Note: The contrast pins in each AAPM CT Performance Phantom are identical in density to the contrast pins of similar material in every other Fluke Biomedical CT Phantom. For example, the nylon pin in every CT Phantom we manufacture has the same density. | |
| This uniform density among all Fluke Biomedical phantoms provides the user with a standard for comparing the performance of different scanners | |

# 76-410-4130

## AAPM CT Performance Phantom

FLUKE® Biomedical

## Specifications

| | |
|---|---|
| **Resolution insert** | |
| **Dimensions** (ODxL) | (7.5 in x 2.5 in) with 6 inch diameter solid acrylic block |
| **76-410-4130** | Block has eight sets of five holes: 1.75 mm, 1.5 mm, 1.25 mm, 1.00 mm, 0.75 mm, 0.61 mm, 0.5 mm, and 0.4 mm round |
| **76-410-4132** | Block has nine sets of five holes: 1.75 mm, 1.5 mm, 1.25 mm, 1.00 mm, 0.75 mm, 0.61 mm, 0.5 mm, 0.4 mm, and 0.2 mm round |
| In both phantom inserts, the holes are spaced longitudinally on 5 mm centers and vertically on centers equal to twice the hole width. All cavities are filled with air. The 6 inch block is sectored 1.25 inch out on radius. The insert contains 0.014 inch stainless steel wire positioned longitudinally to the insert plates. The wire allows simple computation of linespread functions. A sectored 1.25 inch portion of the main 6 inch block permits an edge gradient to be measured. | |
| **Beam width insert** | |
| **Dimensions** (ODxL) | (7.5 in x 3.5 in) |
| Contains three 0.020 in x 1.00 in aluminum strips angled at 45°, positioned on the center line and displayed vertically. A simple, direct calculation permits the accurate measurement of beam width. Adjacency is determined merely by a double exposure of two adjacent frames. | |
| **Low-contrast extension** | |
| **Dimensions** (ODxL) | (8.5 in x 2.75 in) solid acrylic block |
| Has two each of the following 2.25 inch deep cavities: 1 in, 0.75 in, 0.5 in, 0.375 in, 0.25 in, and 0.125 in diameter, spaced twice the appropriate diameter apart, one row of cavities on each side of the center line. Cavities with screw-locking sealing ports are easily filled with dextrose or sodium chloride solutions of various densities. The user may adjust densities to any value suitable for the scanner. Typically, 2 % or 3 % differentials in density between cavities are used | |
| **Alignment pin** | |
| **Dimensions** (ODxL) | (0.25 in x 3 in) aluminum with tapped hole, allowing pin to be secured to cover plate |
| **TLD insert** | |
| **Dimensions** (ODxL) | (0.5 in x 3.5 in) polystyrene rod drilled 3 inch deep to accept TLD inserts |
| Resealable cavity. Tapped on other end to allow mounting to cover plate. | |
| **External (whole-body) resolution and noise ring (76-411)** | |
| Annulus 12 in OD x 8.5 in ID x 2.5 in long contains the same hole pattern as the Resolution Insert, at two locations 90° apart. Permits whole-body resolution and noise measurements when positioned on the main tank. Inner and outer resolution values are easily determined. | |
| **CT-SSP insert (76-412)** | |
| The CT-SSP (Slice Sensitivity Profile) Point Response Phantom can be used as a stand-alone phantom or as an insert with the AAPM CT Performance Phantom. The AAPM CT Performance Phantom meets the guidelines in AAPM Report #1 for Performance Evaluation and QC of CT Scanners. The AAPM CT Performance Phantom is described in the report by the AAPM Task Force on CT Scanner Phantoms. The acrylic and closed-cell foam ball bearing size is 0.01 in, diameter is 7.5 in, width is 3.5 in, and weight is 0.825 lb. | |
| **Low-Contrast CT Resolution Insert (76-421)** | |
| The insert consists of an almost-water-equivalent plastic disc, 201 mm Ø x 25 mm thick, protected on both sides by clear plastic. The resolution targets are a series of water-filled holes from 2.5 mm to 7.5 mm in Ø, in 0.5 mm steps. For each target size, the center-to-center distance between holes is twice the hole diameter to ensure meaningful resolution testing. The insert's 25 mm thickness eliminates alignment problems. Dimensions are 201.6 cm x 32.5 cm thick. Weight is 1 lb. | |
| **Dimensions** (ØxD) | 21.59 cm x 39.37 cm (8.5 in x 15.5 in) |
| **Weight** | 7.84 kg (17.25 lb) |

### Optional accessories

**76-411** External (Whole-Body) Resolution and Noise Ring

**76-412** CT-SSP Point Response Phantom

**76-421** Low-Contrast CT Resolution Insert

### Ordering information

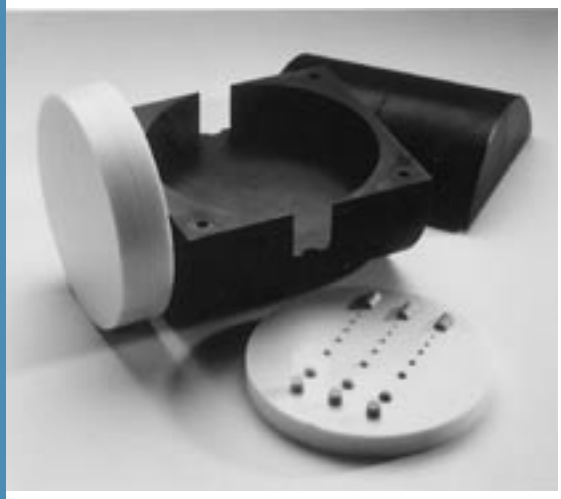
**76-410-4130** AAPM CT Performance Phantom with Resolution Insert (to 0.4 mm)

**76-410-4132** AAPM CT Performance Phantom with Resolution Insert (to 0.2 mm)

# 76-409

## Spiral/Helical CT Lesion Detectability Phantom

FLUKE® Biomedical



The 76-409 CT Lesion Detectability Phantom is particularly useful to physicians, CT technologists, and medical physicists who design scanning protocols for abdominal, pelvic, and brain CT. It allows users to test various scanning protocols to verify that small low contrast lesions will be detected. This is the only way to be sure that a CT scanner is "seeing" tumors that are known to be present. The use of this phantom removes any doubt as to the limit of low contrast spherical lesion detectability for various scan protocols.

The phantom is designed to permit complete testing of low contrast lesion detection when various scan or image reconstruction parameters are varied. These include: collimation, pitch, reconstructed field of view, reconstruction algorithm, z-axis (patient's long axis) interpolators, kVp, mA, and rotation time. This lesion detectability testing can be applied to protocols designed for imaging of the liver, spleen, pancreas, kidneys, and adrenal glands. It can also be used for mass detection in the brain.

### Key features

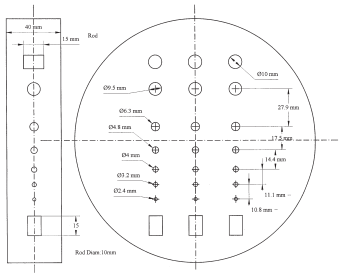
- Incorporates clinically relevant lesion shape (spherical) and size
- Provides clinically relevant absolute HU values for soft tissue
- Provides a clinically relevant HU differential (i.e. tumors have a slightly lower HU than background)
- Designed for use on all conventional and spiral (helical) CT scanners
- Compact, rugged
- Features three cylindrical reference plugs made of the same material as the spherical lesions
- Valid for x-ray energies from 80 kVp to 140 kVp
- Background Hounsfield Units (HU) approximate liver tissue
- Contains clinically relevant sphere sizes of 2.4 mm, 3.2 mm, 4 mm, 4.8 mm, 6.3 mm, and 9.5 mm in diameter
- Spheres are 5 HU, 10 HU, and 20 HU below background HU
- Carrying case is designed for use as a phantom support during scanning procedure

## Specifications

| | |
|---|---|
| **Low-contrast sphere diameters** | 2.4 mm, 3.2 mm, 4 mm, 4.8 mm, 6.3 mm and 9.5 mm |
| **Disk dimensions** | 18 cm Ø x 4 cm thick |
| **Phantom dimensions** | 20 cm long x 18 cm Ø |
| **Weight** | 5.4 kg (11.9 lb) |

**Note:** The CT Lesion Detectability Phantom is a tissue-equivalent test object that consists of an 18 cm diameter right circular cylinder with a CT value of 50 HU at 120 kVp. Within the phantom is an 18 cm diameter, 4 cm deep right circular void in which a soft-tissue-equivalent disk (containing low contrast spheres) can be placed. The cylindrical void is in a plane containing the z-axis of the scanner. The soft-tissue-equivalent disk also has a background CT value of 50 HU.

Embedded within the disk are three sets of simulated spherical lesions. One set is 5 HU below background, a second set is 10 HU below background, and the last set is 20 HU below background. Each set contains one sphere each of the following diameters: 2.4 mm, 3.2 mm, 4 mm, 4.8 mm, 6.3 mm, and 9.5 mm. These diameters were chosen to encompass the full range of clinically significant lesions. The disk can also be placed at the end of the phantom when axial scanning detectability testing is desired.



Disk with embedded targets

### Ordering information

**76-409** Spiral/Helical CT Lesion Detectability Phantom

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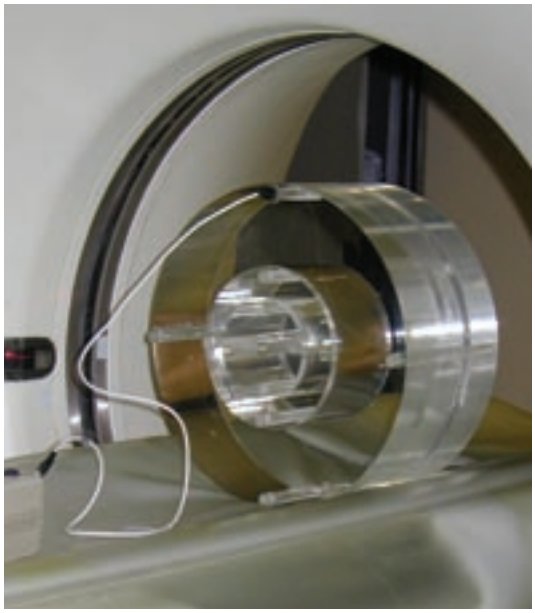
# 76-424-4156

## Nested CT Dose Phantom Kit for Pediatric/Adult Head and Body



The innovative nested CT Dose Phantom can be used with any computed tomography (CT) system designed to image pediatric and adult head and body. Each phantom segment can provide separate dose information. When performing dose profile measurements, the dose phantoms allow the user to collect information for the maximum, minimum, and mid-range value of the nominal tomographic section thickness.

This essential phantom kit consists of three parts: an adult body phantom, an adult head phantom that doubles as a pediatric body phantom, and the new pediatric head phantom, nested together for easy storage and convenient transport. All are made of solid acrylic with diameters of 32 cm, 16 cm and 10 cm, respectively. Each part contains four probe holes around the perimeter, 90° apart and 1 cm from the edge and the pediatric head (center insert) has one probe hole in its center. The inside diameter of the holes is 1.31 cm. Each part includes five acrylic rods for plugging all the holes in the phantom. A sturdy storage and carrying case with wheels and pull handle that holds all three phantoms is included. An optional smaller case without wheels is available.

The CT Dose Phantoms were designed in accordance with the Food and Drug Administration's performance standard for diagnostic x-ray systems, which includes regulations specifically applicable to CT systems (21 CFR 1020.33).

### Key features

- Uniquely designed for pediatric and adult computed tomography dose index (CTDI) in a lightweight 20 kg (44 lb) total package
- Can be used with new multi-detector (MDCT) units
- Meets requirements of FDA performance standards
- All new carrying case with wheels and pull handle
- Case includes space for CT Ion Chambers (purchased separately)

76-424-4156 Kit: Adult body phantom, adult head phantom, pediatric head phantom, and acrylic rods

### Optional accessories

**89-419** Carrying Case with wheels and pull handle for 76-419-4150

**89-414** Carrying Case for 76-414-4150

## Specifications

| 76-424-4156 | |
|---|---|
| **Adult body phantom** | Dimensions: (LxØ): 15.5 cm x 32 cm |
| | Weight: 11.3 kg (25 lb) |
| **Adult head/pediatric body phantom** | Dimensions: (LxØ) 15.5 cm x 16 cm |
| | Weight: 2.3 kg (5 lb) |
| **Pediatric head phantom** | Dimensions: (LxØ) 15 cm x 10 cm |
| | Weight: 1.3 kg (3 lb) |
| **3 nested phantoms** | Weight: 15 kg (33 lb) |

| 76-419-4150 | |
|---|---|
| **Weight** | Body phantom: 14.5 kg (32 lb) |
| | Head phantom: 3.6 kg (8 lb) |

| 76-414-4150 | |
|---|---|
| **Weight** | Body phantom: 14.5 kg (32 lb) |
| | Head phantom: 3.6 kg (8 lb) |
| | Pediatric head phantom: 1.3 kg (2.85 lb) |

### Ordering information

**76-424-4156** Nested CT Dose Phantom Kit for Pediatric/Adult Head and Body including carrying case with wheels and pull handle

**76-424-4150** Nested CT Dose Phantom Kit for Pediatric/Adult Head and Body including carrying case without wheels and pull handle

**76-414-4150** CT Dose Phantom Kit for Adult Head and Body including carrying case

**76-419-4150** CT Dose Phantom Kit for Pediatric/Adult Head and Body including carrying case with wheels and pull handle

**76-419** CT Pediatric Head Dose Phantom with five plugs

**76-414** CT Head Dose Phantom with five plugs

**76-415** CT Body Dose Phantom with five plugs

# CT Ion Chambers

## CT Ion Chambers

## Specifications

| 10 cc high sensitivity | |
|---|---|
| **Detector type** | Vented air ion chamber |
| **Volume** | 10.1 cc |
| **Sensitive length** | 10 cm |
| **Chamber material** | Acrylic (PMMA) |
| **Chamber outside diameter** | 12.7 mm ± 0.4 mm (0.5 in ± 0.015 in) |
| **Chamber inside diameter** | 11.44 mm (0.45 in) |
| **Chamber wall thickness** | 77 mg/cm$^2$ |
| **Electrode material** | Aluminum, 1100 |
| **Sensitivity** | 3.2 R•cm/nC (nominal) or 0.3/nC |
| **Standard calibration** | 100 kVCP, 5.5 mm Al HVL (NIST Tech. M100) |
| **Response uniformity along axis** | ± 3 % over central 90 % of active length |
| **Beam orientation** | Normal to chamber axis |
| **Leakage current** | (300 V collection potential) Less than $10^{-14}$ A at 10 min polarization time |
| **Intensity limits** | Continuous beam: 31.6 R/sec, (1 % recombination loss) |
| **Pulsed beam** | 15.8 mR/pulse (1 % recombination loss) |
| **Collection time** | 0.478 mSec |
| **Cable length** | 0.9 m (3 ft) |
| **Operating voltage** | -300 V |

| 3.2 cc | |
|---|---|
| **Detector type** | Vented air ion chamber |
| **Volume** | 3.2 cc |
| **Sensitive length** | 10 cm |
| **Chamber material** | Polystyrene |
| **Chamber inside diameter** | 6.4 mm |
| **Chamber wall thickness** | 54 mg/cm$^2$ |
| **Electrode material** | Aluminum |
| **Sensitivity** | 10 R•cm/nC (nominal) |
| **Standard calibration** | 100 kVCP, 5.5 mm Al HVL (NIST Tech. M100) |
| **Response uniformity along axis** | ± 3 % over central 90 % of active length |
| **Beam orientation** | Normal to chamber axis |
| **Phantom adapter OD** | 1.27 ± 0.04 cm (0.5 ± 0.015 in) |
| **Leakage current (300 V collection potential)** | Less than 1013 A at 10 min polarization time, less than 1014 A at 2 hour polarization time |
| **Intensity limits** | Continuous beam: 4.86 kR/min (1 % recombination loss) |
| **Pulsed beam** | 51.5 mR/pulse (1 % recombination loss) |
| **Maximum pulse repetition rate** | 3.3 kHz |
| **Cable length** | 0.9 m (3 ft) |
| **Operating voltage** | -300 V |

10 cc high sensitivity ion chamber

3.2 cc ion chamber

### Ordering information

**660-6** CT Ion Chamber, 3.2 cm$^3$, with UHF termination: used with the 660 Electrometer

**500-100** CT Ion Chamber, 3.2 cm$^3$, with triax BNC: used with the 35040 (ATD), TRIAD™ and TRIAD™ TnT

**500-200** CT Ion Chamber High Sensitivity, 10 cm$^3$ for multislice CT, with triax BNC: used with the 35040 ATD and other electrometer/dosimeters, including TRIAD and TRIAD TnT

**6000-100** CT Ion Chamber, 3.2 cm$^3$, with coax BNC for signal and banana plug for bias: used with the 4000, 8000 and RAD-CHECK® Plus Dosimeter

**6000-200** CT Ion Chamber High Sensitivity, 10 cm$^3$, for multislice CT, with coax BNC for signal and banana plug for bias: used with the 4000, 8000 and RAD-CHECK Plus Dosimeter

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# 76-430

## Mini CT QC Phantom

The 76-430 Mini CT QC Phantom phantom is designed for routine monitoring of the consistency of all the major parameters of computed tomography (CT) image quality and radiation dose. Its unique, compact design allows for unparalleled portability, easy set up and reliable parameter determinations. It is perfect for use by physicists, technologists and service engineers.

The disc section consists of a 1 inch thick Lucite® disc with a 6 inch diameter. The six large holes are for the placement of inserts for evaluation of CT number consistency and evaluation of image resolution. The four small holes are for inserting an ion chamber at different locations within the phantom. Lucite inserts are provided to fill the four small holes, when necessary. The disc section is attached to a rectangular acrylic bar containing a thin copper wire embedded along a central groove. This section of the phantom is used to evaluate laser beam alignment and accuracy of slice thickness, slice spacing, slice contiguity, and pilot scan to transverse (longitudinal) scan correspondence. This is achieved by exposing a non-screen film (such as Flex Film Cassettes, listed below) placed underneath the phantom, and making several cuts while the phantom is advanced along the gantry in a pre-programmed manner.

## Specifications

| | |
|---|---|
| **Dimensions** | 6 inch Ø, 1 in thick, with six 1.125 in through-holes and four 0.5 in through-holes |
| **Lucite disk** | The Lucite disk is attached to the side of the base by two removable nylon, slotted screws |
| **Inserts** | Phantom is supplied with seven inserts for 1.125 in holes; 1 each of: Plastic Water®, bone-equivalent, polystyrene, polycarbonate, polyethylene, nylon, and one acrylic high-contrast resolution insert |
| **Lucite base** (LxWxT) | (11.94 in x 1.81 in x 0.69 in), with copper wire (approx. 0.02 in) fixed into a 0.02 in deep groove centered on the base |
| **Weight** | 1.36 kg (3 lb) |

### Ordering information

**76-430** Mini CT QC Phantom, includes seven inserts
**76-430-5555** Mini CT QC Phantom Kit, includes phantom, seven standard inserts, all seven optional inserts, teflon-bone semi-ring and carrying case

### Key features

- Lightweight, compact, and extremely portable
- Ideal for field service use
- Used with any CT scanner, for measurement and analysis of all major CT scanner functions and radiation dose
- Makes inhomogeneity corrections in radiation oncology

**Accurately evaluates:**

- Laser beam alignment
- Slice thickness, spacing, and contiguity
- Table movement
- CT numbers and noise level
- CT number uniformity
- Relative radiation dose
- Video monitor and image processing equipment
- Scout and axial scan correspondence
- High contrast resolution
- Low contrast resolution (with optional insert)

### Optional accessories

**76-430-1000** Low Contrast Resolution Insert: designed for determining the CT unit's ability to detect slight differences in contrast. Two materials with very similar CT numbers are incorporated into the low contrast resolution insert to assess the low contrast detection capability of the unit
**76-430-2000 and 76-430-3000** Teflon® and Lung Inserts: these inserts provide the CT number and density that are important when treatment planning parameters are being established for radiation therapy patients
**76-430-4000** Teflon-Bone Semi-Ring: this accessory is used as a beam hardening ring for simulating clinical conditions. The ring has been machined to slide easily over the phantom, so that each of the inserts will have the effect of beam hardening
**76-430-1212** Acrylic Insert with Wire, (0.5 in)
**76-430-6000** Acrylic Insert
**76-430-7000** Fillable Insert
**76-430-8000** Aluminum Insert
**89-430** Carrying Case
**07-800-5007** Flex Film Cassette, (5 in x 7 in)
**07-800-8010** Flex Film Cassette, (8 in x 10 in)
**07-800-1012** Flex Film Cassette, (10 in x 12 in)

# 76-432

## CT Spiral Phantom*

The accurate indexing capability and exceptional image quality of the computed tomography (CT) scanners not only guarantee the object's location and its size and shape, but also improve the diagnosis accuracy. The index and performance parameters of the CT scanners cannot be confirmed without objects of known specifications. The 76-432 CT Spiral Phantom provides specific details necessary to confirm the integrity of both conventional and spiral scanning. What makes the phantom unique is that it allows the user to visually evaluate all test results in their image displays.

The 76-432 consists of five Lucite® plates of different sizes, all affixed to a flat rectangular base. Specific hole patterns are drilled on each side of these plates. When imaging, the holes within the x-ray field will appear in the phantom images. By the hole appearance, both index and performance parameters can be confirmed qualitatively and quantitatively.

**Parameters that can be confirmed by the phantom, based on the hole appearance in the phantom images include**

**Index parameters**

- Light localizer orientation
- Light localizer and image slice congruence
- Slice thickness accuracy
- Gantry inclination
- Couch index accuracy
- Ruler (angle and distance) accuracy

**Performance parameters**

- Slice geometric uniformity
- Image geometric distortion
- Image slice overlap
- Slice thickness change by pitch factor and image interpolation
- Noise level of imaging protocols

**This versatile phantom can be used by**

**Research laboratories, for:**

- Testing image reconstruction algorithms and interpolation approaches

### Key features

- A supplemental phantom to the CT Performance Phantom, described in a report by the AAPM task force on CT scanner phantoms
- Quality of axial and spiral scanning can be assured
- Accuracy of clinical diagnosis based on the object's size, shape and location will be improved
- Users can evaluate scanners objectively and independently of CT manufacturers
- No film exposures and no radiation profile measurements are necessary
- All test results can be evaluated visually by the users in their image displays
- Scanner evaluation is more realistic; what you scan, is what you see

**CT manufacturers, to:**

- Evaluate equipment hardware design
- Improve imaging software
- Facilitate equipment installation, calibration, and preventive maintenance

**End users, to:**

- Set up baseline standards for future reference
- Verify scanner performance in the acceptance test
- Assist in routine equipment quality control testing
- Evaluate vendor-supported imaging protocols
- Customize image parameters for special applications

**Regulatory agencies, to:**

- Set up the standards for CT scanners, and measure their compliance

*Designed by Jung T. Ho, Ph.D., Department of Radiology, LAC+USC Medical Center, Los Angelos, California 90033.

## Specifications

| | |
|---|---|
| **Material** | Lucite |
| **Plate dimensions** | 10 cm x 10 cm, 15 cm x 15 cm, 20 cm x 20 cm, 25 cm x 25 cm |
| **Phantom dimensions** (WxDxH) | 25 cm x 20 cm x 25 cm |
| **Weight** | 8.2 kg (7.18 lb) |

### Ordering information

**76-432** CT Spiral Phantom, with Bubble Level

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# 84-357

## Interventional Triple-Modality 3D Abdominal Phantom

Needle not included

The 84-357 Interventional Triple-Modality 3D Abdominal Phantom is made from proprietary materials which accurately mimic human tissues under magnetic resonance imaging (MRI), ultrasound, and computed tomography (CT). It is designed for image-guided interventional procedures.

The 84-357 contains simulated lungs, liver, hepatic vessels, ribs, vertebra, kidneys, abdominal aorta, inferior vena cava, muscle fat and interstitial tissues. Embedded within the lung and liver are simulated lesions available in a range of sizes and relative contrasts.

Each phantom is protected by a fat-equivalent urethane membrane and ABS end-caps. These features make the phantom durable enough for extended scanning sessions and enable insertion of various surgical instruments, as needed.

### Key features

- Mimics human tissue for MRI, ultrasound and CT
- Designed for training, quality control and demonstrating scan techniques
- Improve performance of free-hand abdominal biopsies
- Test new equipment
- Validate automated biopsy systems
- Demonstrate CT, ultrasound and MRI scan techniques
- Optimize imaging protocols

## Specifications

| | |
|---|---|
| **Material** | Zerdine®[1], urethane, epoxy, and ABS |
| **Dimensions** (WxDxH) | 28 cm x 12.5 cm x 20 cm |
| **Weight** | 5.5 kg (12 lb) |

[1]US Patent #5196343

### Ordering information

**84-357** Interventional Triple-Modality 3D Abdominal Phantom

# 76-907 and 76-908

## Uniformity/Linearity Phantom (AAPM) and MR 3D Slice Thickness Resolution Phantom

FLUKE® Biomedical

76-907

**76-907 MR Uniformity/ Linearity Phantom (AAPM)**
The 76-907 Uniformity/ Linearity Phantom was designed to conform to AAPM MRI specifications. This large, flat-flood phantom can be filled with an MR signal-producing solution. The orthogonal array holes contain orientation reference markers, and the flood section has an image artifact cylinder.

76-908

**76-908 MR 3D Slice Thickness/High Contrast Resolution Phantom (AAPM)**
Various sections are arranged within a cubical shape to make the 76-908 truly three-dimensional. The 76-908 3D Slice Thickness Resolution Phantom contains slice thickness measuring sections, and a void between the inserts to allow for a signal-producing solution. Slice thickness and resolution information can be obtained in all three directions (transaxial, coronal, and sagittal) without moving the phantom.

### Key features

**76-907**
**Accurately evaluates:**
- Spatial linearity
- Image artifact
- Signal-to-noise
- Resonance frequency
- Quadrature error

**76-908**
**Accurately evaluates:**
- High-contrast resolution
- Slice thickness
- Gradient strength
- Slice position/separation
- Resonance frequency
- Designed to conform to AAPM MRI specifications*

*These phantoms conform to the AAPM Specifications contained in the report: "Quality Assurance Methods and Phantoms for Magnetic Resonance Imaging," issued by the AAPM NMR Task Group No. 1 (article appeared in Medical Physics, 17:2 (Mar/Apr 1990). This report has also been co-sponsored by the American College of Radiology MR Committee on Imaging Technology and Equipment.

## Specifications

| 76-907 | |
|---|---|
| **Dimensions** (WxDxH) | 33.02 cm x 33.02 cm x 10.16 cm (13 in x 13 in x 4 in) |
| **Weight** | 5.3 kg (11.68 lb) |

| 76-908 | |
|---|---|
| **Dimensions** (WxDxH) | 15.24 cm x 15.24 cm x 12.7 cm (6 in x 6 in x 5 in) |
| **Weight** | 1.56 kg (3.46 lb) |
| **Phantom configuration** | |
| **Resolution section** | Six sections |
| | Square holes: 0.5 mm, 0.75 mm, 1 mm and 2 mm |
| | Hole depth: 0.5 in |
| **Slice thickness** | 1 mm or 2 mm gap |
| | Slice position/separation |
| | Gradient strength |
| **Slice thickness ramp section** | Four sections |
| | 2 with 1 mm gap |
| | 2 with 2 mm gap |

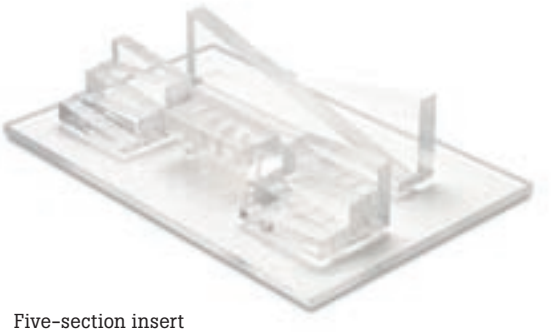
### Optional accessories
**76-903-7000** Copper Sulfate, 1 gm/l

### Ordering information
**76-907** Uniformity/Linearity Phantom (AAPM)
**76-908** 3D Slice Thickness/High Contrast Resolution Phantom (AAPM)

FLUKE®
Biomedical

# 76-904

## MRI Surface Coil Phantom*



Five-section insert

The use of surface coils in Magnetic Resonance Imaging (MRI) has become an important part of the clinical operations in most MR facilities. Surface coils are preferred in some MR studies, in part, because their use can minimize motion artifacts, obtain high signal-to-noise ratio in the areas closer to the surface, and obtain high resolution images of smaller areas of interest.

The 76-904 MRI Surface Coil Phantom was specifically designed for acceptance testing and routine QC of surface coils. It provides the proper geometry not found in conventional head or body phantoms.

The 76-904 is constructed of non-magnetic Plexiglas®. It is rectangular in shape, contains three inserts, and is designed to be filled with an MRI signal-producing solution. The void between the inserts provides a fully flooded area.

### Key features

- Provides proper geometry not found in conventional head or body phantoms

**Accurately evaluates:**

- High spatial resolution
- RF signal brightness profile
- Slice thickness
- Slice to slice gap
- MTF evaluation
- Magnetic field uniformity
- Gradient linearity
- Image artifacts
- And more!

## Specifications

| | |
|---|---|
| **Outer dimensions** (WxDxH) | 33.02 cm x 15.24 cm x 17.46 cm (13 in x 6 in x 6.875 in) |
| **Inner dimensions** (WxDxH) | 30.49 cm x 12.7 cm x 15.24 cm (12 in x 5 in x 6 in) |
| **Weight** | 3.61 kg (7.96 lb) |

*Developed by Seong Ki Mun, Ph.D., Department of Radiology, Georgetown University Hospital, Washington, DC.

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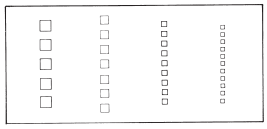
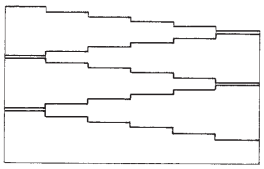
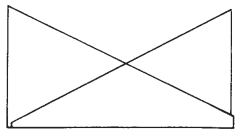
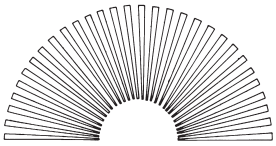
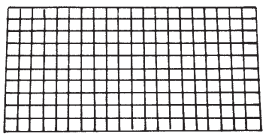
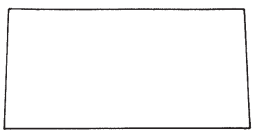
# 76-904

## MRI Surface Coil Phantom

## Specifications

**A wide range of tests are provided by individual phantom sections**

| | | |
|---|---|---|
| **High-resolution hole pattern** | | |
|  | Five holes: 2 mm x 2 mm<br>Seven holes: 1 mm x 1 mm<br>Nine holes: 0.75 mm x 0.75 mm<br>Eleven holes: 0.5 mm x 0.5 mm<br>Hole depth: 9 mm | |
| **Folded step ramps** | | |
|  | • Slice thickness, profile<br>• Interslice gap<br>• Slice orientation evaluation | Step interval: 1 mm<br>Range: 30 mm<br>Step size: 10 x 10 mm |
| **Matching pair of ramps** | | |
|  | • Precision slice definition evaluation | 160 mm run, 40 mm rise (4:1 ratio). 0.5 in thick |
| **Star pattern** | | |
|  | • Qualitative MTF evaluation<br>• Resolution<br>• Asymmetric resolution<br>• Image artifacts | Thirty 3° wedges (60 mm x 30 mm) covering a 180° fan shape. 0.785 mm gap at narrow end, 3 mm gap on wide end |
| **Square grid** | | |
|  | • RF intensity profile<br>• Magnetic field uniformity<br>• Gradient linearity<br>• Aspect ratio | Dimensions 0.5 x 0.5 gird of 12 in x 6 in x 0.375 in thick |
| **Flood section** | | |
|  | • RF signal uniformity<br>• Single $T_1$ and $T_2$ values | Dimensions 12 in x 5 in x 6 in |

### Optional accessories

**76-903-7000** Copper Sulfate, 1 gm/l

### Ordering information

**76-904** MRI Surface Coil Phantom

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# 76-903

## MRI Multipurpose Phantom*

Five-section insert

The 76-903 MRI Multipurpose Phantom monitors the overall performance of an MRI system. The parameters that can be measured include: slice thickness, slice orientation, interslice gap, magnetic field homogeneity, radio frequency signal uniformity, spatial resolution in positive and negative contrast, and modulation transfer function (MTF). The phantom can also be used to evaluate quadrature setting, baseline correction, aspect ratio, and single $T_1$ and $T_2$ values.

The 76-903 is constructed of non-magnetic materials. It is 9 inches in diameter, with two inserts, and is designed to be filled with an MRI signal-producing solution. One insert is a series of concentric conic sections. The other insert is made up of five sections: one for positive contrast, two for slice evaluation, one for MTF evaluation, one for $T_1$ and $T_2$ evaluations.

A void between the sections provides a fully flooded area for signal uniformity.

### Key features

**Provides a comprehensive range of tests in one compact unit**

- Slice thickness
- MTF evaluation
- Spatial resolution
- RF signal uniformity
- Magnetic field homogeneity

## Specifications

| Sections | Segments provided |
|---|---|
| **Folded step ramps** | two 60° |
| **Star pattern** | one 120° |
| **T1, T2 solution insert** | one 60° |
| **High-resolution hole pattern** | one 60° |
| **Flood section** | one 360° |
| **Concentric conic section** | one 360° |
| **General** | |
| **Phantom dimensions** (WxH) | OD is (9 in x 4.5 in) |
| **Weight** | 3.09 kg (6.82 lb) |

*Developed by Seong Ki Mun, Ph.D., Department of Radiology, Georgetown University Hospital, Washington, DC.

# 76-903

## MRI Multipurpose Phantom

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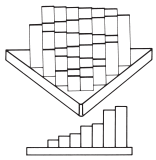
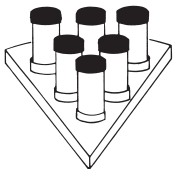
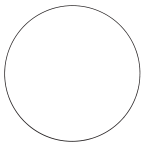
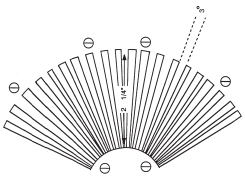
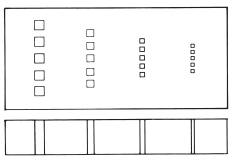
## Specifications

**Individual phantom inserts and sections permit a wide range of tests**

| | | |
|---|---|---|
| **Folded step ramps** | | |
|  | • Slice thickness<br>• Slice orientation<br>• Interslice gap | Step Interval: 1 mm<br>Range: 36 mm |
| **$T_1$ and $T_2$ solution insert** | | |
|  | Six 5 cc refillable glass vials with caps 15 mm Ø x 47 mm (h) | |
| **Flood section** | | |
|  | Diameter 9 in<br>Depth 1.25 in | |
| **Star pattern** | | |
|  | • MTF evaluation<br>• Horizontal and vertical spatial resolution<br>• Quadrature setting<br>• Baseline correction | Wedge angle: 3°<br>Number of wedges: 20<br>Fan angle: 60°<br>Wedge length: 60 mm<br>Height: 30 mm |
| **High-resolution hole pattern** | | |
|  | Four holes: 2 mm x 2 mm,<br>1 mm x 1 mm,<br>0.75 mm x 0.75 mm,<br>0.5 mm x 0.5 mm<br>Hole depth: 9 mm | |
| **Concentric conic section** | | |
| | Outside diameter: 8 in<br>Number of segments: 4 | |

### Optional accessories

**76-903-7000** Copper Sulfate, 1 gm/l

### Ordering information

**76-903** MRI Multipurpose Phantom

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# 84-555

## Ultrasound Phantoms Set for 2D and 3D Evaluation

The 84-555 for 2D and 3D Evaluation Ultrasound Phantoms consists of two phantoms as described in the AIUM publication "Standard Methods for Calibration of 2-Dimensional and 3-Dimensional Spatial Measurement Capabilities of Pulse Echo Ultrasound Imaging Systems." These phantoms were designed to evaluate measurements taken on ultrasound systems using newer spatial encoding algorithms. This is especially important for the 3D and 4D ultrasound systems currently on the market.

Both phantoms are manufactured from a water-based polymer called Zerdine®[1] and housed in rugged ABS containers that minimize desiccation. The background is calibrated to mimic the ultrasound characteristics of human liver tissue. Unlike other phantom materials, Zerdine®[1] is not damaged by changes in temperature.

84-555A is a volumetric target phantom and contains a small egg and a large egg. There are two scanning surfaces and the targets are off centered within the background material.

Depending upon what side is scanned, the test objects are located at distances ranging from 2 cm to 6 cm from the scanning surface.

84-555B is a wire-target phantom that can be used to measure linear and curved dimensions as well as perimeters, volumes and surface areas. It may also be used to determine image uniformity and depth of penetration.

The phantoms come with a rugged carrying case, a copy of the above referenced AIUM publication as a user's guide and handling instructions.

### Key features

- Complies with AIUM standards
- Simulates characteristics of the human liver
- Perfect for QC/Service—not affected by changes in temperature
- Rugged carrying case included

[1]US Patent #5196343.

# 84-555

## Ultrasound Phantoms Set for 2D and 3D Evaluation

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## Specifications

| 84-555A | |
|---|---|
| **Material** | Zerdine, solid elastic water-based polymer; Freezing point: 0 °C (32 °F); Melting point: above 100 °C (212 °F) |
| **Attenuation coefficient** | 0.5 dB/cm/MHz ± 0.05 dB/cm/MHz |
| **Speed of sound** | 1540 m/s ± 6 m/s |
| **Targets** | 9 dB ± 3 dB lower than background |
| **Depth of targets** | 2 cm to 6 cm from scanning surface |
| **Volume of targets** | Small egg: 6.7 cc, Large egg: 65.0 cc |
| **Scanning membrane** | Saran-based |
| **Dimensions (nominal)** (LxWxH) | 15 cm x 15 cm x 14.7 cm (5.9 in x 5.9 in x 5.79 in) |
| **84-555B** | |
| **Material** | Zerdine, solid elastic water-based polymer; Freezing point: 0 °C (32 °F); Melting point: above 100 °C (212 °F) |
| **Attenuation coefficient** | 0.5 dB/cm/MHz ± 0.05 dB/cm/MHz |
| **Speed of sound** | 540 m/s ± 6 m/s |
| **Targets** | See pattern |
| **Scanning membrane** | Saran-based |
| **Dimensions (nominal)** (LxWxH) | 10 cm x 15 cm x 18.5 cm (4 in x 5.9 in x 7.3 in) |
| **Scanning membrane** | Saran-based |

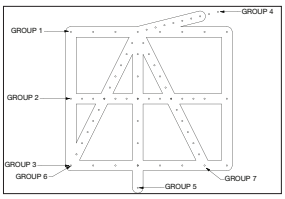

Figure 1-A

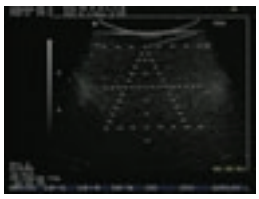
Figure 1-B

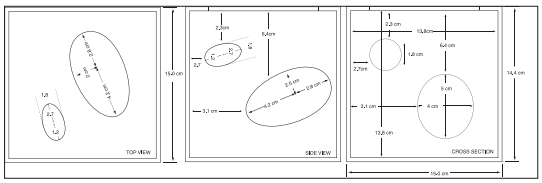
Figure 2-A

Figure 2-B

### Ordering information

**84-555** Ultrasound Phantoms for 2D and 3D Evaluation, set
**84-555A** Volumetric Target Phantom
**84-555B** Wire Target Phantom

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# 84-347

## Gray-Scale Ultrasound Phantom

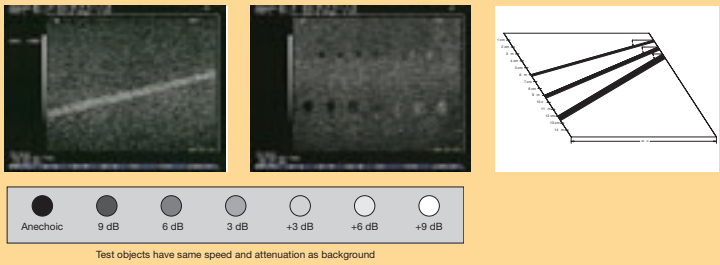
The newly designed 84-347 Gray Scale Ultrasound Phantom uses proven, patented materials to permit rapid visualization of gray scale resolution power at continuous depths from 1 cm to 12 cm.

84-347 is a single simple tool used to assess resolution of masses, varying in size, depth and contrast.

This gray-scale ultrasound phantom is usable on all diagnostic ultrasound machines, thus allowing user evaluation of gray-scale sensitivity with a wide range of transducer frequencies. This phantom is an ideal training tool for learning optimum system setup and evaluating system performance.

Masses may be viewed with either a circular or elliptical cross-section. The mass diameters were selected so the volume imaged would double as the diameter increased. The gray-scale levels were selected to achieve a doubling in signal intensity as you move from mass to mass. The anechoic masses comply with the ACR accreditation program.

84-347 is manufactured from Zerdine®[1]—a solid-elastic polymer whose elastic properties can be controlled independently of its acoustic properties.



Test objects have same speed and attenuation as background

### Key features

- 21 testing objects, Diameters: 2.4 mm, 4 mm, and 6.4 mm, Contrast: anechoic, -9, -6, -3, +3, +6, and +9 dB
- Depth of test object varies continuously as phantom is scanned laterally
- Scatter controlled independently from attenuation
- For evaluating resolving power as a function of depth, size and contrast
- Complies with ACR accreditation programs
- Rapid visualization of gray scale resolution
- Continuous depth from 1 cm to 12 cm
- Carrying case included

[1]US Patent #5196343.

## Specifications

| | |
|---|---|
| **Material** | Zerdine, solid elastic water-based polymer.<br>Freezing point: 0 °C (32 °F)<br>Melting point: above 100 °C (212 °F)<br>Scanning membrane: Saran-based laminate |
| **Background** | Attenuation coefficient: 0.5 dB/cm/MHz ± 0.05 dB/cm/MHz<br>Speed of sound: 1540 m/s ± 6 m/s<br>Contrast: 0 dB |
| **Targets** | Attenuation coefficient: 0.5 dB/cm/MHz ± 0.05 dB/cm/MHz<br>Speed of sound: 1540 m/s<br>Contrast: Anechoic, -9 dB, -6 dB, -3 dB, 6 dB, and 9 dB<br>Diameters: 2.4 mm, 4 mm, and 6.4 mm<br>Depth Range: 3 mm, 1 cm to 6 cm, 4 mm, 2 cm to 9 cm, 6 mm, and 3 cm to 12 cm |
| **Dimensions** (LxWxH) | 13 cm x 35 cm x 17 cm (5.12 in x 13.78 in x 6.7 in)<br>Scanning well: 1 cm (deep) |
| **Weight** | 10.45 kg (23 lb) |

### Ordering information

**84-347** Gray Scale Ultrasound Phantom

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# 84-349

## Ultrasound Elasticity QA Phantom

The 84-349 Ultrasound Elasticity QA Phantom contains 10 mm and 20 mm diameter spheres of varying hardness relative to the background material. The spheres are located at depths of 15 mm and 35 mm respectively and will appear isoechoic to the background using standard B-mode imaging. All materials are tested and a certification is provided listing the acoustic and elastic properties of each tissue.

Housed in a durable ABS housing with flexible scanning surface, 84-349 is manufactured from Zerdine®[1]—a solid-elastic polymer whose elastic properties can be controlled independently of its acoustic properties. The phantom is a reliable and consistent elasticity reference tool useful for researchers, sales demonstrations and quality assurance testing.

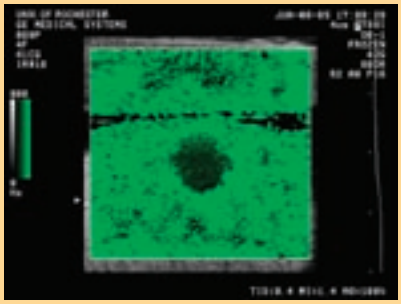
### Key features

- Provide users with targets of known hardness
- 10 mm and 20 mm diameter spheres
- 15 mm and 30 mm depth placements
- 4 separate hardnesses
- Spheres appear isoechoic on standard B-mode imaging

[1]US Patent #5196343.

## Specifications

| | |
|---|---|
| **Background** | Material: Zerdine, solid elastic water-based polymer. |
| | Freezing point: 0 °C (32 °F), Melting point: above 100 °C (212 °F) |
| | Speed of sound: 1540 m/s ± 6 m/s |
| | Attenuation coefficient: 0.5 dB/cm/MHz ± 0.05 dB/cm/MHz |
| | Contrast: 90 db with respect to reference |
| **Lesions** | Material: Zerdine, solid elastic water-based polymer. |
| | Freezing point: 0 °C (32 °F), Melting point: above 100 °C (212 °F) |
| | Speed of sound: 1545 m/s ± 6 m/s |
| | Attenuation coefficient: 0.5 dB/cm/MHz ± 0.05 dB/cm/MHz |
| | Contrast: 90 db with respect to reference |
| **Elasticity** | Lesion Type I 16 kPa ± 8 % |
| | Lesion Type II 25 kPa ± 8 % |
| | Lesion Type III 44 kPa ± 8 % |
| | Lesion Type IV 56 kPa ± 8 % |
| **Diameter** | Qty. 4, 10 mm at 15 mm depth one of each hardness |
| | Qty. 4, 20 mm at 30 mm depth one of each hardness |



Elastograph image courtesy of C. Wu at the University of Rochester

### Ordering information

**84-349** Ultrasound Elasticity QA Phantom

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# 84-317

## Multipurpose Tissue-Cyst Ultrasound Phantom

The 84-317 Multipurpose Tissue/Cyst Ultrasound Phantom helps provide both quantitative and qualitative information on the performance of all diagnostic ultrasound imaging systems. When used on a regular basis, it promotes uniform system performance, better patient data, and more productive work schedules. Imaging equipment can be evaluated for axial and lateral resolution, vertical and horizontal distance calibration and linearity, and ring down.

This updated and improved phantom is filled with Zerdine®, a solid-elastic, water-based polymer that exhibits echogenic patterns similar to those encountered in human liver parenchyma. Unlike other phantom materials, Zerdine is elastic and is not damaged by heavier scanning pressures. It is also highly-resistant to damage by extreme temperatures.

### Key features

- Complies with the AIUM standard for quality assurance
- The best-performing phantom in the industry, for evaluating system and transducer performance
- Includes cyst-like and solid structures in various sizes
- Simulates liver tissue scattering and attenuation
- Now available with 0.5 or 0.7 dB/cm/MHz attenuation coefficients
- Provides resolution targets at several depths
- Compatible with all types of imaging equipment, including small parts scanners
- Withstands extreme temperatures, making it ideal for service and quality control use
- Three large scanning surfaces

## Specifications

| | |
|---|---|
| **Phantom body** | |
| **Phantom material** | Zerdine[1]; solid-elastic water-based polymer |
| **Freezing point** | 0 °C |
| **Melting point above** | 100 °C |
| **Storage temperature** | 0 °C to 66 °C (32 °F to 150 °F) |
| **Speed of sound** | 1540 m/s ± 6 m/s |
| **Attenuation coefficient** | 0.5 dB/cm/MHz or 0.7 dB/cm/MHz |
| **Scatter** | Mimics healthy liver parenchyma |
| **Positional tolerance of wires (monofilaments)** | Stated distance ± 0.1 mm |
| **Diameter of cylindrical targets** | Stated Diameter ± 5 % |
| **Base material** | Cork |
| **Phantom dimensions** (WxHxT) | 20 cm x 2 cm x 8 cm (7.87 in x 8.26 in x 3.15 in) |
| **Weight** | 3.36 kg (7.4 lb) |
| **Optional scanning trough** | |
| For scanning with a liquid coupling agent (water or coupling oil) | |
| **Optional carrying case** | |
| This insulated case is large enough to hold the phantom and trough and also protects the phantom from extreme heat or cold | |
| **Optional acoustic standoffs** | |
| A fast, easy, accurate way to bring the focal zone closer to the surface, for enhanced diagnostic detail during ultrasound examinations | |
| Material | Sonolucent gel |
| Dimensions | 10 cm x 15 cm |
| Weight | 0.42 kg (1 lb) |

[1]US Patent #5196343.

### Optional accessories

**84-318** Scanning Trough: for Oil and Water

**89-317** Carrying Case: insulated for phantom and trough

**84-325-1000** Acoustic Standoff, 1.0 cm

**84-325-2000** Acoustic Standoff, 2.0 cm

**84-325-3000** Acoustic Standoff, 3.0 cm

**84-325** Acoustic Standoff, 4.0 cm

**84-325-1234** Acoustic Standoff Set, includes all four: 1 cm, 2 cm, 3 cm and 4 cm

### Ordering information

**84-317** Multipurpose Tissue/Cyst Ultrasound Phantom, 0.5 dB/cm/MHz

**84-314** Multipurpose Tissue/Cyst Ultrasound Phantom Kit, consists of phantom (either 0.5 dB/cm/MHz or 0.7 dB/cm/MHz), scanning trough, carrying case, and the "AIUM Quality Assurance Manual"

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# 84-340

## General Purpose Mulit-Tissue Ultrasound Phantom

The 84-340 General Purpose Multi-tissue Ultrasound Phantom is constructed from a patented solid elastic material called Zerdine®. Unlike other phantom materials, it is not affected by changes in temperature. It can be subjected to boiling or freezing conditions without sustaining significant damage. It is also more elastic than other materials and allows more pressure to be applied to the scanning surface without subsequent damage to the material.

At normal room temperature, Zerdine will accurately simulate the ultrasound characteristics found in human liver tissue. It contains dense and cystic masses in a range of sizes, one high-density target, and an assortment of nylon monofilament target groups. It was designed to allow for assessment of linearity, axial and lateral resolution, depth calibration, dead zone measurement, and registration within two different backgrounds of 0.5 dB/cm/MHz and 0.7 dB/cm/MHz. The phantom is protected by an acrylic case and plastic membrane to facilitate scanning and minimize desiccation.

### Key features

- Complies with the AIUM Standard for Quality Assurance
- Simulates characteristics found in human liver tissue
- Ensures patient's safety and doctor's confidence
- Perfect for QC/service use since phantom is not affected by changes in temperature
- Promotes uniform system performance for all types of imaging equipment, including small parts scanners
- Supplied with insulated, rugged storage/carrying case
- Quick scanning can be performed without removing phantom from the airtight case

## Specifications

| | |
|---|---|
| **Material** | Zerdine[1]<br>Type: Solid elastic water-based polymer<br>Freezing point: 0 °C<br>Melting point: Above 100 °C |
| **Attenuation coefficient** | 0.5 dB/cm/MHz; 0.7 dB/cm/MHz |
| **Speed of sound** | 1540 m/s |
| **Scanning well** | 1 cm deep |
| **Scanning membrane** | Saran |
| **Targets** | Material: Monofilament nylon wire<br>Diameter: 0.1 mm |
| **Vertical and horizontal plane target** | Number of groups: 1<br>Number of targets: 7<br>Depth range: 9 cm<br>Spacing: 2 cm |
| **Resolution targets** | Number of arrays: 3<br>Depths: 3 cm and 10 cm<br>Axial intervals: 0.5 mm, 1 mm, 2 mm, 3 mm, 4 mm, and 5 mm<br>Horizontal intervals: 1 mm, 2 mm, 3 mm, 4 mm, and 5 mm |
| **Low contrast targets** | Number of targets: 4<br>Diameter of targets: 2 mm, 4 mm, 6 mm, and 8 mm<br>Depth of targets: 2 cm, 4 cm, 6 cm, and 8 cm<br>Contrast of targets: –15 dB relative to background |
| **High contrast targets** | Number of targets: 4<br>Diameter of targets: 2 mm, 4 mm, 6 mm, and 8 mm<br>Depth of targets: 2 cm, 4 cm, 6 cm, and 8 cm<br>Contrast of targets: 15 dB relative to background |
| **Phantom dimensions** (WxDxH) | 19 cm x 20 cm x 14 cm (7.5 in x 8 in x 5.5 in) |
| **Weight** | 9.1 kg (20 lb) with case |
| **Carrying case** (WxDxH) | 46 cm x 38 cm x 43 cm (18 in x 15 in x 17 in) |

| **Tolerances** |
|---|
| Distance between any two wires equals stated ± 0.38 mm |
| Cylinder diameters equal state ± 5 % |
| **Accuracy of measured parameters** |
| Speed of sound equals stated ± 3 m/s |
| Attenuation coefficient equals stated ± 0.02 dB/cm/MHz |
| **Temperature at time of measurement** |
| Recorded on certification document |

### Ordering information

**84-340** General Purpose Multi-tissue Ultrasound Phantom

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# 84-342

## General Purpose Urethane Ultrasound Phantom

The 84-342 General Purpose Urethane Ultrasound Phantom offers a reliable medium which contains specific, known test objects, making it more accurate than random scannable materials. The phantom enables repeatable, qualitative assessment of ultrasound scanner performance over time. The phantom is constructed from a proprietary urethane matrix, housed within a rigid PVC container with three separate scanning windows. It allows for depth of penetration, uniformity, distance calibration, resolution and lesion detectability assessment. The three scanning surfaces also provide the user with the ultimate in versatility, simplicity and ease of use. The scanning wells permit either water or gel to be used as an acoustic coupling agent.

### Key features

- Features three scan-surfaces
- Complies with the AIUM standard for quality assurance
- Rugged, durable
- Ideal for service use
- Performs a wide variety of tests needed to meet AIUM and ACR ultrasound QC guidelines
- Includes an in-house certification traceable to NIST standards

## Specifications

| | |
|---|---|
| **Phantom material** | Proprietary urethane matrix |
| **Attenuation coefficient** | 0.5 dB/cm/MHz ± 0.05 dB/cm/MHz at 5 MHz |
| **Speed of sound** | 1430 m/s ± 10 m/s at 20 °C |
| **Scanning surfaces** | Number: 3<br>Depth of scanning wells: 2 cm |
| **Housing material** | White PVC |
| **Vertical plane targets** | Number of groups: 1<br>Number of targets per group: 10<br>Depth of visualization: 1 cm and 19 cm<br>Visualized spacing: 20 ± 0.38 mm<br>Material: Nylon monofilament, 0.10 mm Ø |
| **Horizontal plane targets** (**Note:** This target group is also the Vertical Plane Target Group) | Number of groups: 1<br>Number of targets per group: 10<br>Depth of visualization: 3 cm and 10 cm<br>Visualized spacing: 20 ± 0.35 mm<br>Material: Nylon monofilament, 0.1 mm Ø |
| **Axial resolution targets** | Number of groups: 2<br>Number of targets per group: 12<br>Depths of visualization: 2 cm, 5 cm, 8 cm, and 11 cm<br>Axial resolution test range: 0.5 mm, 1 mm to 5 mm, in 1 mm increments<br>Material: Nylon monofilament, 0.1 mm Ø |
| **Lateral resolution targets** | Number of groups: 2<br>Number of targets per group: 6<br>Depths of visualization: 2 cm, 5 cm, 8 cm, and 11 cm<br>Lateral resolution test range: 1 mm to 5 mm, in 1 mm increments<br>Material: Nylon monofilament, 0.1 Ø |
| **Anechoic targets** | Number of targets: 2<br>Diameter: 8 mm to 2 mm, in 2 mm increments<br>Depths of visualization 2 cm, 5 cm, 8 cm, 11 cm, 13 cm, and 16 cm |
| **Phantom dimensions** (WxDxT) | 17 cm x 25.5 cm x 7 cm (6 in x 10 in x 2.75 in) |
| **Weight** | 5.45 kg (12 lb) |

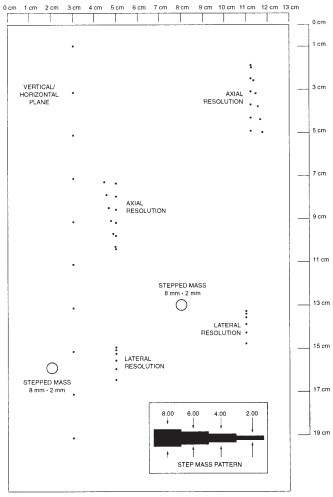

Diagram showing internal targets

### Ordering information

**84-342** General Purpose Urethane Ultrasound Phantom, includes carrying case

# Service and Calibration

## World-class facility. World-class service.

Fluke Biomedical's Global Calibration Lab is NVLAP Lab Code 200566-0 accredited, adheres to ISO 17025:2005, ANSI Z540, Mammography MQSA, and CNSC, and is traceable to national and international standards.

Fluke Biomedical offers one-stop, bulk contracts for managing larger instrument pools, including various asset-management alternatives for pools larger than 150 units. Fluke Biomedical's asset-management program takes over your grueling task of instrument tracking and allows you to use your time more productively.

If you have a large number of instruments that require service, you can greatly benefit from this quality service. Proper protocols are strictly followed, eliminating the problems with inspectors and audits that can result when other less-qualified labs perform the calibrations. Instrumentation includes Fluke Biomedical as well as other industry models.

**Fluke Biomedical's Global Calibration Laboratory is equipped to calibrate and repair the following types of instruments:**

- Area Monitors
- Barometers
- Blood Pressure Simulators
- Defibrillators/External Pace Maker Analyzers
- Densitometers
- Diode Detectors
- Dosimeters
- Electrical Safety Analyzers
- Incubator Analyzers
- Ion Chambers
- IV Pump Analyzers
- kVp Meters
- mAs Meters
- Electrical Multimeters
- Oscilloscopes
- Patient Simulators
- Pressure Meters/Parameter Testers
- Radiation Multimeters
- Sensitometers
- SpO2 Simulators/Analyzers
- Thermometers
- Test Lungs
- Ultra Sound Analyzers
- Velometers
- Ventilators/Gas flow Analyzers

## Calibration Beam Specifications

### Tungsten Anode

**NIST-Traceable Techniques**

| Equivalent Beam Code | Potential (kV) | Filtration | | | | HVL mm Al |
|---|---|---|---|---|---|---|
| | | mm Al | mm Cu | mm Sn | mm Pb | |
| L20 | 20 | | | | | 0.07 |
| L100 | 100 | 1.98 | | | | 2.75 |
| M30 | 30 | 0.50 | | | | 0.33 |
| M50 | 50 | 1.00 | | | | 0.98 |
| M60 | 60 | 1.50 | | | | 1.68 |
| M80 | 80 | 2.6 | | | | 2.98 |
| M100 | 100 | 5.0 | | | | 5.1 |
| M150 | 150 | 5.0 | 0.25 | | | 10.2 |
| M200 | 200 | 4.1 | 1.12 | | | 14.9 |
| M250 | 250 | 5.0 | 3.2 | | | 18.5 |
| H50 | 50 | 4.0 | | | 0.12 | 4.4 |
| H60 | 60 | 4.0 | 0.6 | | | 6 |
| H100 | 100 | 4.0 | 5 | | | 13.5 |
| H150 | 150 | 4.0 | 4 | 1.5 | | 16.8 |
| H200 | 200 | 4 | 0.6 | 4 | 0.7 | 19.5 |
| H250 | 250 | 4 | 0.6 | 1 | 2.7 | 21.5 |

**PTB-Traceable Techinques**

| Equivalent Beam Code | Potential (kV) | Filtration | | | | HVL mm Al |
|---|---|---|---|---|---|---|
| | | mm Al | mm Cu | mm Sn | mm Pb | |
| DV30 | 30 | 2.5 | | | | 0.98 |
| DV40 | 40 | 2.5 | | | | 1.44 |
| DV50 | 50 | 2.5 | | | | 1.81 |
| DV60 | 60 | 2.5 | | | | 2.13 |
| DV70 | 70 | 2.5 | | | | 2.45 |
| DV80 | 80 | 2.5 | | | | 2.78 |
| DV90 | 90 | 2.5 | | | | 3.1 |
| DV100 | 100 | 2.5 | | | | 3.48 |
| DV120 | 120 | 2.5 | | | | 4.15 |
| DV150 | 150 | 2.5 | | | | 5.36 |
| DH40 | 40 | 4 | | | | 2.2 |
| DH50 | 50 | 10 | | | | 3.75 |
| DH60 | 60 | 16 | | | | 5.35 |
| DH70 | 70 | 21 | | | | 6.77 |
| DH80 | 80 | 26.0 | | | | 8.12 |
| DH90 | 90 | 30.0 | | | | 9.26 |
| DH100 | 100 | 34.0 | | | | 10.15 |
| DH120 | 120 | 40.0 | | | | 11.67 |
| DH150 | 150 | 45.0 | | | | 13.36 |

# Service and Calibration

**World-class facility. World-class service.**

FLUKE® Biomedical

## Calibration Beam Specifications

### Molybdenum/Rhodium Anode

**NIST-Traceable Techniques**

| Equivalent Beam Code | Potential (kV) | Filtration | | | HVL mm Al |
|---|---|---|---|---|---|
| | | mm Mo | mm Rh | mm Al | |
| Mo/Mo 28 | 28 | 0.032 | | | 0.33 |
| Mo/Mo 35 | 35 | 0.032 | | | 0.39 |
| Mo/Rh 28 | 28 | 0.029 | | | 0.41 |
| Rh/Rh 25 | 25 | | 0.029 | | 0.35 |
| Rh/Rh 40 | 40 | | 0.029 | | 0.56 |
| Mo/Mo28x | 28 | 0.030 | | 2 | 0.63 |
| Rh/Rh/35x | 35 | | 0.029 | 2 | 0.898 |

**PTB-Traceable Techinques**

| Equivalent Beam Code | Potential (kV) | Filtration | | | HVL mm Al |
|---|---|---|---|---|---|
| | | mm Mo | mm Rh | mm Al | |
| MV20 | 20 | 0.030 | | | 0.223 |
| MV25 | 25 | 0.030 | | | 0.282 |
| MV30 | 30 | 0.030 | | | 0.337 |
| MV35 | 35 | 0.030 | | | 0.374 |
| MV40 | 40 | 0.030 | | | 0.402 |
| MV50 | 50 | 0.030 | | | 0.440 |
| MV20 | 20 | 0.030 | | 2 | 0.450 |
| MV25 | 25 | 0.030 | | 2 | 0.580 |
| MV30 | 30 | 0.030 | | 2 | 0.670 |
| MV35 | 35 | 0.030 | | 2 | 0.749 |
| MV40 | 40 | 0.030 | | 2 | 0.825 |
| MV50 | 50 | 0.030 | | 2 | 0.968 |

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**www.flukebiomedical.com/service**

# Publications

## The following Fluke Biomedical catalogs are also available

### Fluke Biomedical Radiation Oncology QA

The Radiation Oncology QA catalog provides a full range of QA solutions for the Radiation Oncology Physicist, Therapist, and Dosimetrist. The catalog contains information about the linear accelerator QA instrumentS, radiation oncology chambers, phantoms, and accessories needed to manage radiation oncology QA and maintain a safe, regulatory-compliant facility.

**For more information, contact sales@flukebiomedical.com**

### Fluke Biomedical Radiation Safety

The Radiation Safety catalog highlights devices used to measure radiation levels, manage regulatory QA requirements, and aide in radiation emergencies. These devices are intended for Radiation Safety Officers (RSOs), Health Physicists, Emergency Responders and other radiation-minded professionals. The catalog contains information about a variety of survey meters and probes, area monitors, and other radiation-monitoring accessories.

**For more information, contact sales@flukebiomedical.com**

### Fluke Biomedical Test

The Biomedical Test catalog emphasizes the complete line of biomedical test and simulation products for Biomedical/Clinical Engineers and Technicians. The catalog contains information about Fluke Biomedical's test and simulation products, including standalone electrical safety testers, patient simulators, and performance analyzers, as well as fully integrated and automated performance-testing and documentation systems.

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Printed in U.S.A. 6/2009 3077923B C-EN-N